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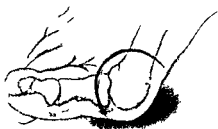


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# SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE PUBLISHED MONTHLY

VOLUME XVII

JULY 1928

NUMBER 1

## SYMPTOMS PRODUCED BY DISTENSION OF THE GALLBLADDER AND BILIARY DUCTS<sup>1</sup>

A CLINICAL AND EXPERIMENTAL STUDY

By A. SCHRAGER, M.D. and A. C. JAY, Ph.D., M.D., Chicago  
Assisted by M. KRONENBERG, M.D. and P. DYARST, B.S.

FOR many years one of us (Schrager) has observed that certain cases of biliary colic are associated with respiratory embarrassment at the height of an attack. It is our purpose to point out the clinical significance of this phenomenon and to present a detailed experimental study of the symptoms produced by distention of the gall bladder and biliary passages.

In 1908 Schrager was summoned to the bedside of a young woman 18 years of age who 3 days previously had had a normal delivery. She was suddenly seized with a severe upper abdominal pain associated with an unusual respiratory embarrassment which lasted about 45 minutes subsided abruptly and recurred in the same manner twice in the following 5 days. Several weeks thereafter a similar attack occurred. The pain was more definitely localized in the right hypochondrium radiated to the back and in other respects assumed a frank picture of gall stone colic. Since the original observation Schrager has seen a number of cases of upper abdominal distress associated with respiratory difficulty following delivery, especially in young primiparae. Several of these cases came to the operating table and it was observed that the degree of respiratory difficulty depended upon the degree of distention of the gall bladder wall

or the mechanical obstruction of the cystic duct. Several cases of hydrops of the gall bladder markedly exhibited this respiratory phenomenon. This was found to be especially true when the cystic duct was blocked by a large stone.

A very striking case was that of a woman 49 years of age who was suddenly taken ill with a very severe pain over the base of the right lung which was associated with respiratory embarrassment. A physician related to the patient saw her several times within 48 hours and made a diagnosis of acute pleurisy. Strapping of the chest, salicylates and opiates gave the patient no relief. Questioning of the patient disclosed the information that for the past 25 years she had had similar attacks associated with pain in the right hypochondrium. Physical examination revealed a very marked tenderness below the right costal arch associated with marked resistance to pressure. Because of previous experiences Schrager was not confused by the respiratory phenomenon and location of the pain over the base of the right lung and diagnosed the condition as due to a distended gall bladder. Operation revealed an extreme hydrops of the gall bladder the organ was distended to the breaking point and contained a clear mucoid fluid. The cystic duct was impacted with a date like stone which was forced out with difficulty even after the removal of the gall bladder.

As time went on Schrager learned to ascribe definite significance to the respiratory embarrassment associated with upper abdominal colic and quite uniformly found it to mean

<sup>1</sup> From the Department of Physiology, St. Mary's Hospital, Chicago, Ill., and the University of Chicago School of Medicine, Chicago, Ill.



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gall bladder distention with or without impaction of the cystic duct. In a limited number of cases the pain instead of radiating toward the back and shoulder is referred to the mid sternum. In people aged about 50 or more, this clinical complex may suggest angina pectoris. The anaminal picture associated with gall bladder pathology is at times confusing and able clinicians have to weigh the evidence very carefully before arriving at a final diagnosis. This differentiation becomes more difficult when there are actual organic heart changes associated with chronic gall bladder pathology. The reaction of the cardiovascular system to gall bladder pathology, we believe, depends upon the latent condition of the heart at the time the gall bladder stimulus is set in action.

An illustrative case that of a man 55 years of age who has been ill with pain in the right upper abdomen for several months. He has been told by the physician that he has a gall bladder stone and that he should have it removed. He has been told by the physician that he has a gall bladder stone and that he should have it removed. He has been told by the physician that he has a gall bladder stone and that he should have it removed.

Consulting the literature we found very few allusions to the symptom of respiratory embarrassment in gall bladder disease. Llewellyn Sale (9) takes much for granted when he states: "Limitation of diaphragm movement in the presence of certain intra abdominal lesions is well known. There is a casual mention of the respiratory phenomenon by Moynihan

Choyce and A. B. John. Moynihan, describing a typical biliary attack, states that the breathing is difficult because of spasm of the diaphragm which like other abdominal muscles is tightly contracted to form that firm muscular splint the purpose of which is to keep at rest and free from harm the region in need of protection. Choyce speaks of the catching of breath in the more severe varieties of gall stone colic.

Bodenstab (11) analyzing a series of 500 cases of gall stones operated upon either by Quaine or Parnstedt found that dyspnea was present in 43 cases. He ascribed this phenomenon to a spasm of the diaphragm which limits its excursion and causes shortness of breath. The latter symptom has often been mistaken for pleurisy or pneumonia.

Crile, in the chapter on surgical physiology in Keen's *System of Surgery* (12) writes: "The reflex phenomena in gall stone colic from a diagnostic standpoint are most interesting. There is scarcely a subjective symptom so important as the inhibition of the diaphragm in gall stone colic. The inhibitory paths through afferent nerves supplying the gall bladder region which are located in adjoining segments of the spinal cord to that of the phrenics to which the impulse is transferred is an explanation of this important phenomenon. Almost every case of gall bladder or gall stone colic if questioned will give the history of inhibition of the diaphragm during the attack. The diagnostic importance of this symptom is increased greatly by the fact that such inhibition occurs in almost no other instance. In a personal communication Crile states: 'I can confirm what you have said concerning respiratory phenomena accompanying obstruction of the cystic duct. This symptom is routinely sought for in my clinic at the Lake Side Hospital.'

Llewellyn Sale, in a paper before the section of practice of medicine at the sixty-seventh annual session of the American Medical Association held in Chicago in June 1918, discussed the subject of diaphragmatic contractions associated with acute abdominal conditions especially appendicitis. His control examination on soldiers in good health and without either thoracic or abdominal symp-

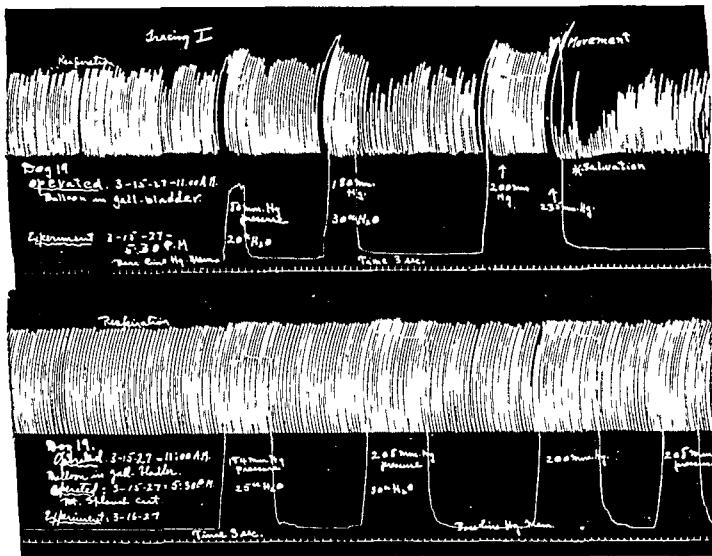


Fig. 2 In this experiment a balloon was placed in the gall bladder. The upper tracing of this figure shows the effect of distending the gall bladder on respiration. Note the inhibition of respiration and the salivation. After the upper tracing, as made the right splanchnic nerve was cut. Distention of the gall bladder then caused no symptoms. In some cases, after section of the right splanchnic, we observed some inhibition of respiration and some nausea. Salivation denotes nausea.

toms showed no difference in the excursion of the two halves of the diaphragm; occasionally there was slightly greater excursion on the right side. Diaphragmatic limitation was observed by Sale not only in cases in which the corresponding peritoneal surface of the diaphragm was involved but also in cases in which the pathological lesion was distant. Sale's observations are original and interesting. Similar observations were made by Hubeny (4) who found diaphragmatic limitation in a case of gastric ulcer at the oesophageal junction. He speaks of unilateral peculiar fluffing of the diaphragmatic arcs in abdominal disease and concludes that "should these fluffings be present pathology of some

kind should be suspected." Hughes (5) found cessation of function of the diaphragm on the corresponding side of the abdominal lesion if the peritoneal surface was irritated by an inflammatory process.

The acceptance of the inhibitory reflex obvious to the afore mentioned observers is not quite clear physiologically as the phrenic nerve has no known inhibitory fibers unless it is due to an inhibition of the motor phrenic center in the cord (Sale). In a discussion of Sale's paper J. Birney Guthrie of New Orleans alludes to the diaphragmatic sign as Williams sign. He compares the splinting of the diaphragm in neighboring pathology to the splinting of muscles in chest diseases.



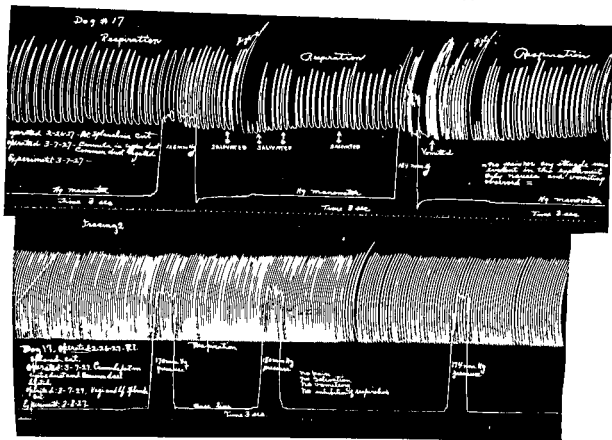


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such as Litten's sign or the fixation of muscles around joint diseases or the wasting of thoracic muscles in pulmonary tuberculosis.

Pottenger (8) in the same discussion classifies the diaphragmatic sign as viscerogenetic reflex. He states: "I do not believe that we can explain this reflex through the phrenic nerve. It must be through the lower intercostals. The phrenics take their origin from the third and fourth cervical segments of the cord and are in reflex communication with afferent impulses which come from the lung. The abdominal viscera however are supplied by the sympathetic nerves which take their origin from the lower 6 thoracic segments of the cord. Afferent sensory impulses traveling centralward from the abdominal viscera transmit their impulses to the 6 lower intercostal nerves which supply the intercostal

muscles; the central portion of the diaphragm and the abdominal muscles. Professor Erlanger likens the diaphragmatic inhibition to that of the abdominal muscles in the vicinity of acute inflammatory processes. In a personal communication Sale accepts the possibility of voluntary inhibition of one half of the diaphragm. The paper of Sale and the discussion thereof are quoted extensively as they constitute the most elaborate document we have been able to find in the literature in support of the phenomenon of diaphragmatic inhibition.

On the whole the diagnosis of the pathologic gall bladder has become as obvious as that of appendicitis especially since the introduction of the Graham-Cole test. However we still meet with disappointments and surprises and large group clinics with excellent clinical

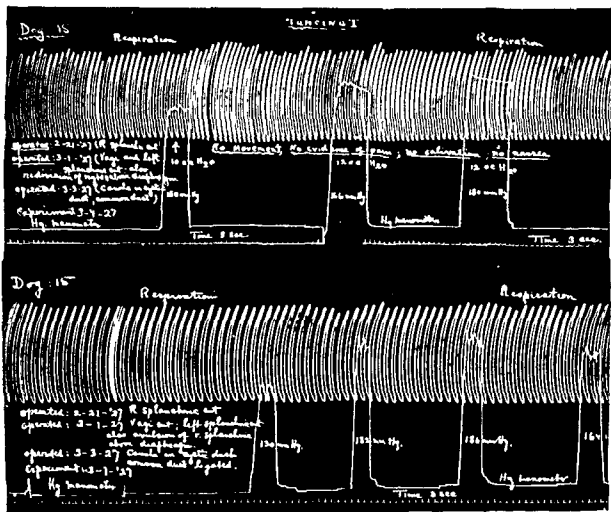


Fig 4 The right splanchnic nerve of this dog was cut on February 1, 1927 and the vagi and left splanchnic nerves were cut on March 1. On March 3 the common bile duct was doubly ligated and the cystic duct cannulated. Distention caused no symptoms.

and laboratory facilities not infrequently miss or misdiagnose pathology of the gall bladder. The presence of respiratory embarrassment associated with an upper abdominal complex has been a valuable aid in the diagnosis of pathologic gall bladder and cystic ducts and has seldom deceived us. It is rather strange that medical literature so prolific on all phases of the subject should be totally silent on the subject.

The scarcity of data concerning this symptom prompted us to undertake physiological experiments.

#### PHYSIOLOGICAL ASPECT

Because of the clinical relationship between disease of the biliary passages and the respiratory mechanism noted by one of us (Schrager) we were stimulated not only to study the effect of distention of the gall bladder

and biliary passage on respiration but also to study the course taken by sensations produced by distention which result in objective symptoms namely inhibition of respiration, distress, nausea and vomiting and to observe the occurrence of other concomitant phenomena.

#### METHODS

In the experiments in which the effects of distending the gall bladder were studied a toy balloon attached to a hard rubber tube was placed in the gall bladder through an incision in its dome. By a T tube the tube coming from the balloon could be connected with a mercury manometer for recording pressure. The balloon was distended with water at 39 or 40 degrees centigrade a 50 cubic centimeter syringe being used so that the amount of water used could be measured.



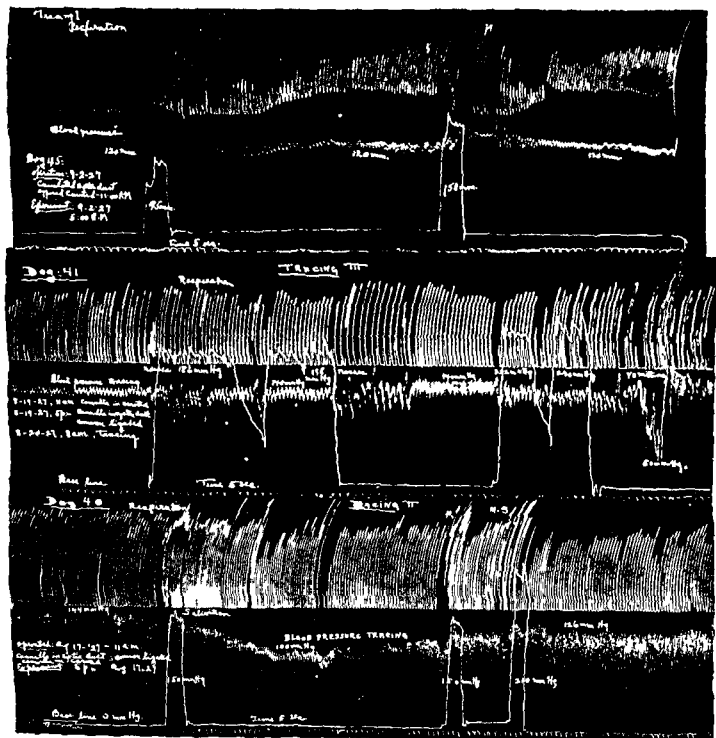
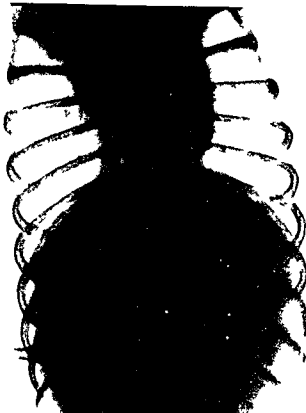


Fig 6 This figure shows simultaneous blood pressure and respiratory tracing from 3 animals on distention of the biliary ducts. The response varied in each animal. On the right of the middle tracing can be seen the effect of vomiting on blood pressure.

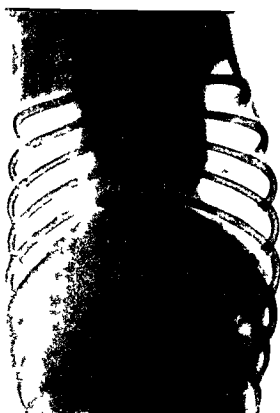
# RESULTS

**Distention of the gall bladder** In these experiments we looked especially for the following reflex manifestations: (1) distress, (2) inhibition of respiration, (3) salivation, which denotes nausea in the dog, and (4) vomiting.

The gall bladder was distended in 2 dogs. Of these 2 had the vagi and left splanchnic cut, 4 had the right splanchnic cut, and 4 had both vagi and splanchnics cut. We generalize in this manner because it is impossible to publish all of our data relative to these experiments.



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Our observations on distention of the gall bladder can be summarized as follows (a) Distention of the gall bladder causes distress inhibition of respiration and occasionally salivation and vomiting. The distress was not marked when compared with the distress caused by distention of the biliary passage. In one dog marked distention (40 milligrams of mercury) of the gall bladder caused no distress. The inhibition of respiration always occurred but was more marked in some dogs than in others. It was in most instances inspiratory in type. Salivation denoting nausea occurred in approximately 40 per cent of the dogs whereas vomiting only occurred once and then when food was in the stomach. That vomiting is more readily elicited when the stomach is filled with food or when it is showing hunger contractions has been the observation of one of us (Ivy). (b) Section of the right splanchnic nerve in 3 dogs abolished all reflexes. (c) Section of the vagi and left splanchnic in 4 dogs abolished reflexes for from 24 to 48 hours after which distress occurred on distention. Marked distention with 100 cubic centimeters of water caused distress at all times in these dogs.

The amount of pressure necessary to cause the inhibition of respiration was less than the amount necessary to cause salivation and distress. The minimal pressure required to elicit reflexes varied widely in different dogs; the minimal observed was 40 millimeters of mercury with 30 cubic centimeters of water.

*Distention of the cystic and biliary ducts*  
In these experiments the water at 39 or 40 degrees centigrade came into contact with the walls of the ducts since a balloon could not be used. The water was injected through the tube attached to the cannula in the cystic duct the common bile duct being doubly tied. The ducts were distended in 8 dogs. Of the 8, 4 had the vagi and left splanchnic cut, 4 had the right splanchnic cut and 6 had both vagi and splanchnics cut.

Our observations may be summarized as follows: (a) Distention of the biliary ducts causes marked distress inhibition of respiration usually inspiratory in type salivation or nausea always if the pressure is above 100 millimeters of mercury and frequently vomit-

ing. It was very evident that the symptoms were more severe and uniform when the biliary ducts were distended than when the gall bladder was distended. Symptoms could be elicited with less pressure the minimum being 40 millimeters of mercury and 7 cubic centimeters of water. (b) Section of the right splanchnic nerve abolished the distress in all experiments and reduced the degree of inhibition of respiration. The amount of change in inhibition of respiration following right splanchnic section varied in different dogs; some dogs showing very little change and others showing 150 per cent change. (c) Section of the vagi and left splanchnic abolished the salivation and vomiting and reduced the respiratory inhibition in all experiments. The reduction of respiratory inhibition was more marked following vagus section than following right splanchnic section. (d) Section of both vagi and splanchnic nerves abolished all reflexes unless the distention was very great (over 300 milligrams of mercury).

*The effect of drugs on the symptoms produced by distention of the biliary ducts. Procaine instillations.* From 10 to 15 cubic centimeters of 1 per cent procaine was injected into the biliary ducts in 4 experiments. In from 5 to 10 minutes after the procaine injection distention of the ducts elicited no symptoms except in 1 dog on marked distention (40 milligrams of mercury). The effect of the procaine lasted about 10 minutes. The procaine was absorbed very rapidly from the ducts and 2 of the dogs had mild convulsions and one other muscular twitchings from which they recovered. After instillation of procaine we observed that from 5 to 10 cubic centimeters more of water was required to produce pressures equivalent to those prior to the instillation denoting a decrease in tone of the biliary ducts.

*Cocaine hydrochloride subcutaneously.* One milligram of cocaine hydrochloride per kilogram body weight was injected hypodermically in dogs with the cystic duct cannulated and the common duct doubly ligated. It was found that this dose of cocaine completely abolished the symptoms caused by distention in two animals and definitely ameliorated

the symptoms in the other two. From 10 to 30 minutes were required before the drug became effective. As was the case in procaine instillation more water was required to produce equivalent pressures after cocaine injection than before.

*Morphine atropine subcutaneously.* From  $\frac{1}{4}$  to  $\frac{1}{2}$  grain of morphine sulphate and from  $\frac{1}{40}$  to  $\frac{1}{60}$  grain of atropine sulphate was injected subcutaneously in from 10 to 12 kilo dogs whose ducts were prepared for distention. This injection failed to ameliorate the symptoms produced by distention. When the dose of cocaine was added to this dose of morphine atropine the symptoms were markedly ameliorated.

*Papaverine sulphate.* Papaverine sulphate was used in 2 experiments on one dog with only a slight ameliorating effect.

*Ether.* Moderate ether anesthesia abolished all symptoms. Under very light ether anesthesia the inhibition of respiration could be elicited sometimes and at other times not. This is the reason why it was absolutely necessary for us to allow our animals to recover from anesthesia.

*Right splanchnic nerve blocked with procaine.* After considerable practice in locating and injecting the right splanchnic nerve in dead dogs we injected or infiltrated the right splanchnic nerve of dogs prepared for biliary duct distention with 2 per cent procaine solution colored with gentian violet. This was done in order to ascertain whether or not the pain impulses could be blocked by such a procedure. We found that although we were successful in infiltrating the nerve the distress caused by distention was only partially and not completely abolished. In dog 39 the nerve was blocked under direct vision at operation with 1 per cent procaine. One hour later (after the animal had recovered from the anesthesia) distention caused no distress or inhibition of respiration.

*Right splanchnic nerve blocked with 70 per cent alcohol.* The experiments on procaine block were repeated using 70 per cent alcohol under direct observation by operative procedure. It was found that the alcohol block completely abolished the distress caused by distention of the biliary ducts its action

being directly comparable to section of the right splanchnic nerve.

*The effect of distention of the biliary ducts on blood pressure.* Five animals were prepared so that the effect of distention of the bile ducts on the blood pressure could be followed. Thirty four tests were made on the 5 animals.

Our results show that distention of the bile ducts changes the blood pressure and heart rate. The effect however was not uniform. In some tests the pressure rose in some it fell in others it fell and then rose and in others it became very irregular rose and fell as much as 50 millimeters of mercury during the period of distention. In dog 40 we observed all of the variations. In the 4 other dogs (41, 42, 44 and 45) the usual response was that the pressure first fell 10 or 20 millimeters for 10 or 20 seconds and then rose 15 or 30 milligrams for from 1 to 2 minutes. In 2 dogs the rate of the heart was increased in the rate was decreased and in 1 (dog 40) the rate was sometimes increased and at other times decreased.

In dog 40 distention caused skipped beats to appear which persisted for several minutes after the distention. In 1 dog we transplanted the carotid for a blood pressure tracing prior to the operation on the bile ducts. We did this to determine whether or not the placing of the cannula in the cystic duct and the ligation of the common duct had any effect. The result was negative.

*Dilatation of the biliary ducts from continued intermittent distention.* In 3 animals in which the cystic duct was cannulated and the common duct tied and in which the ducts had been distended intermittently for a week we observed that the ducts were definitely dilated. The ducts were filled with a solution containing bismuth and a roentgenogram was made.

*An attempt to study the effect of cholecystitis on the amount of distention required to produce symptoms.* It is quite possible that if the gall bladder or ducts were inflamed less pressure would be required to produce symptom than in the case of a normal gall bladder and ducts because partial asphyxia and inflammation increases the irritability of nerve endings.

In order to study this aspect a balloon was placed in the gall bladder and the minimum pressure required to produce inhibition of respiration and distress was determined. Then 8 cubic centimeters per kilogram body weight of Dr. Kan's solution (pH 9.0 free chlorine 0.48) was injected. Four animals were so prepared and injected. The injection killed all 4 animals within 1 hour.

We are not able to explain the results because we injected 10 normal animals with 10 cubic centimeters of the same solution per kilogram with only 1 death and have injected 5 cholecystectomized dogs without a death.

We next tried to produce a chemical cholangitis by injecting acid into the biliary ducts. The common duct was ligated and the cystic duct cannulated. After the animals recovered from the anesthesia 10 cubic centimeters of 0.1 per cent hydrochloric acid was injected into the biliary ducts. No immediate deleterious results were observed; however the animal died within 1 hour. Marked changes in the liver were noted.

*The effect of distention of the biliary ducts on the position of the diaphragm.* Since roentgenological evidence in cases of biliary colic in man revealed that the right side of the diaphragm was contracted (at a lower level than the left diaphragm) we conducted experiments in order to determine whether or not such contraction would occur in the dog on distention of the ducts.

The common duct was ligated and the cystic duct cannulated. A roentgenogram was made then the ducts were distended and during the respiratory arrest another roentgenogram was made. It was found by such an experiment on 4 animals that the right side of the diaphragm was contracted assuming the position seen at inspiration and at a lower level than the left side of the diaphragm.

To ascertain whether or not this was due to the presence of the cannula in the duct or to the abdominal operation we did the following experiment: (1) We made a roentgenogram of the diaphragm at inspiration before the operation. (2) then we made a roentgenogram at inspiration after a simple right rectus incision was made and closed. (3) then we made

another at inspiration after the incision was opened and the duct cannulated. (4) and finally another on distention of the ducts. The results of this experiment revealed that the position of the diaphragm observed in our other experiments was due solely to the distention of the ducts.

*Distention of the stomach and jejunum.* A dog with a gastric fistula and another with a Thiry fistula of the jejunum were prepared. The rather sudden distention of the stomach with 550 cubic centimeters or more of water caused some inhibition of respiration followed by an increase. It was not as characteristic as the inhibition seen in distention of the biliary passage in that it was not as sudden and not as complete. The same was true of distention of the Thiry fistula of the jejunum.

#### DISCUSSION

Our results definitely demonstrate that inhibition of respiration on distention of the gall bladder and biliary passages is a definite physiological response. The sensory impulse that causes the effect is carried by the vagi and right splanchnic nerves chiefly by the former. Less pressure is required to produce this phenomenon when the cystic duct and other biliary ducts are distended than when the gall bladder is distended. It is possible but not very probable that the response on distention of the gall bladder is due to distention of the cystic duct as occurs on the impaction of a stone in the neck of the gall bladder and first part of the duct because in our gall bladder experiments the cystic duct was not ligated. We did not ligate the cystic duct because we believed that it was impossible to do this without interfering with the nerve supply of the gall bladder. At any rate it is quite obvious from our experiments that a respiratory disturbance must be looked for in colic due to gall bladder or biliary duct diseases especially if the colic is due to the impaction of a stone in either the cystic or common bile duct.

The fact that 1 dog failed to manifest distress or disturbance of any kind when the gall bladder was markedly distended is analogous to the clinical observation that the gall bladder of some patients can be markedly



the symptoms in the other two. From 10 to 30 minutes were required before the drug became effective. As was the case in procaine instillation, more water was required to produce equivalent pressures after cocaine injection than before.

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*In attempt to study the effect of cholecystitis on the amount of distention required to produce symptoms.* It is quite possible that if the gall bladder or ducts were inflamed, less pressure would be required to produce symptoms than in the case of a normal gall bladder and ducts because partial asphyxia and inflammation increases the irritability of nerve endings.

In order to study this aspect a balloon was placed in the gall bladder and the minimum pressure required to produce inhibition of respiration and distress was determined. Then 5 cubic centimeters per kilogram body weight of Dakin's solution (pH 9.0 free chlorine 0.45) was injected. Four animals were so prepared and injected. The injection killed all 4 animals within 12 hours.

We are not able to explain the results because we injected 10 normal animals with 10 cubic centimeters of the same solution per kilogram with only 1 death and have injected 5 cholecystectomized dogs without a death.

We next tried to produce a chemical cholangitis by injecting acid into the biliary duct. The common duct was ligated and the cystic duct cannulated. After the animals recovered from the anesthesia 10 cubic centimeters of 0.2 per cent hydrochloric acid was injected into the biliary ducts. No immediate deleterious results were observed; however, the animal died within 1 hour. Marked changes in the liver were noted.

*The effect of distention of the biliary ducts on the position of the diaphragm.* Since roentgenological evidence in cases of biliary colic in man revealed that the right side of the diaphragm was contracted (at a lower level than the left diaphragm) we conducted experiments in order to determine whether or not such contraction would occur in the dog on distention of the ducts.

The common duct was ligated and the cystic duct cannulated. A roentgenogram was made; then the ducts were distended and during the respiratory arrest another roentgenogram was made. It was found by such an experiment on 4 animals that the right side of the diaphragm was contracted assuming the position seen at inspiration and at a lower level than the left side of the diaphragm.

To ascertain whether or not this was due to the presence of the cannula in the duct or to the abdominal operation we did the following experiment: (1) We made a roentgenogram of the diaphragm at inspiration before the operation; (2) then we made a roentgenogram at inspiration after a simple right rectus incision was made and closed; (3) then we made

another at inspiration after the incision was opened and the duct cannulated; (4) and finally another on distention of the ducts. The results of this experiment revealed that the position of the diaphragm observed in our other experiments was due solely to the distention of the ducts.

*Distention of the stomach and jejunum.* A dog with a gastric fistula and another with a duodenal fistula of the jejunum were prepared. The rather sudden distention of the stomach with 550 cubic centimeters or more of water caused some inhibition of respiration followed by an increase. It was not as characteristic as the inhibition seen in distention of the biliary passage in that it was not as sudden and not as complete. The same was true of distention of the duodenal fistula of the jejunum.

#### DISCUSSION

Our results definitely demonstrate that inhibition of respiration on distention of the gall bladder and biliary passages is a definite physiological response. The sensory impulse that causes the effect is carried by the vagi and right splanchnic nerves chiefly by the former. Less pressure is required to produce this phenomenon when the cystic duct and other biliary ducts are distended than when the gall bladder is distended. It is possible but not very probable that the response on distention of the gall bladder is due to distention of the cystic duct as occurs on the impaction of a stone in the neck of the gall bladder and first part of the duct because in our gall bladder experiments the cystic duct was not ligated. We did not ligate the cystic duct because we believed that it was impossible to do this without interfering with the nerve supply of the gall bladder. At any rate it is quite obvious from our experiments that a respiratory disturbance must be looked for in colic due to gall bladder or biliary duct diseases especially if the colic is due to the impaction of a stone in either the cystic or common bile duct.

The fact that 1 dog failed to manifest distress or disturbance of any kind when the gall bladder was markedly distended is analogous to the clinical observation that the gall bladder of some patients can be markedly

distended with stones etc without any symptoms or with only slight symptoms

The contraction fixation or limitation of movement of the right diaphragm observed by us confirms the observations of others. The most obvious explanation of this phenomenon we believe is the one offered by Moynihan namely that it serves the purpose of demobilizing or splinting the diseased part.

Our results observed following section of the *splanchnics* and *vagi* reveal in a clean cut manner the course taken by afferent sensations from the biliary passages. Our observations on the gall bladder are not so clear cut. It is difficult for us to explain adequately why the distress is temporarily affected by section of the *vagi*. The only explanation that we have to offer is based on the difference of threshold that we have shown to exist between the gall bladder and biliary passages the threshold of the nerves of the gall bladder being higher (more difficult to excite) than that of the biliary passages. This being the case it is possible for purposes of explanation to assume that the section of the *vagi* in some unknown manner raises still higher the threshold of the nerves of the gall bladder and after a day or two the threshold gradually returning toward the normal we again obtain distress on distention. It is also necessary to assume that the threshold of the nerves of the biliary passages is so low (easily excited) that section of the *vagi* although section of the *vagi* may have some effect has no material effect on their threshold or the intensity of the stimulus necessary to stimulate them. Just what role the cerebrum plays in the production of the symptoms we cannot state.

The fact that muscular twitchings and excitement occurred on the injection of procaine into the biliary passages shows that absorption of crystalloids by their mucosa can occur at a rapid rate.

Cocaine was administered subcutaneously because Kast and Meltzer (6) found that visceral pain is abolished by relatively small doses of cocaine subcutaneously which has been confirmed for the lung by Kleitman (7) and because smooth muscle is first stimulated and then depressed by cocaine as well as

procaine. The action of the cocaine on the distress caused by distention was much more definite than any effect of the morphine atropine mixture which we believe was nil. Our observations show that the cocaine decreases the tone of the ducts as well as materially decreases the distress resulting from distention. Our observations we believe warrant the use of cocaine (not more than 60 milligrams or 1 grain subcutaneously) in severe cases of biliary colic that do not respond to morphine atropine provided idiosyncrasy to cocaine is not present in the patient. Our experiments with papaverine were disappointing. However this drug may prove to be efficacious in biliary colic as it occurs in man.

Our results on blocking the right splanchnic nerve show that adequate methods will produce a block of sensations causing distress due to distention of the biliary passages. In order to obtain complete blocking the splanchnic nerve had to be injected under direct vision. When the procaine was injected without direct visualization of the nerve only partial effects were obtained probably because a sufficient amount of procaine did not come into direct contact with the nerve.

Our results on abolishing pain from the biliary passages by section or adequate blocking of the right splanchnic nerve in dogs confirm the findings in man of Kocher, Kaffis, Kulenkampff which have been reviewed and confirmed by De Zakats (3). It is not to be concluded from our observations however that pain sensations from other viscera are carried solely by the right splanchnic nerve.

Our observations on the effect of distention of the biliary passages on blood pressure and heart rate show that sensation from the biliary passages has no specific effect on the cardiovascular system. The cardiovascular system is affected but not in a specific manner. We had expected to observe a fall in pressure and a decrease in heart rate from reflex stimulation of the depressor and vaso-inhibitory centers in the medulla. The variation in response that occurred can be explained by assuming that the character of the response depends entirely on the condition of the cardiovascular system at the time

the biliary passages are distended. The fact that "skipped beats" occurred in 1 dog supports this explanation. Electrocardiograms were made in 2 dogs before during and after biliary duct distention with negative results.

It might be objected that the pressures required to produce symptoms in our dogs are too great to be of any significance. In this connection it should be pointed out that the pressures we recorded were for the most part only approximately correct and that the inflamed gall bladder and biliary passages are quite probably more sensitive than the normal since it is well known that in inflammation generally increases the irritability of nerve endings.

#### SUMMARY

It has been observed clinically that patients with distended gall bladder or with stone impacted in the cystic duct suffer from respiratory embarrassment during an attack of colic. This symptom has been of much value in the differential diagnosis of diseases of the gall bladder and biliary ducts because it is either absent or not significantly present in any other abdominal complex.

Physiological experiments have demonstrated that distention of the gall bladder and biliary ducts causes inhibition of respiration chiefly inspiratory in type. Distention also produces other symptoms such as nausea vomiting and distress in proportion to the degree of distention of the biliary passages. Distention of the biliary ducts causes more striking symptoms than distention of the gall bladder alone.

It has been observed that nausea vomiting and some of the respiratory inhibition are

abolished by section of the vagi and that distress and some respiratory inhibition are likewise abolished by section of the right splanchnic.

Instillation of cocaine or procaine into the bile ducts temporarily abolishes or ameliorates the symptoms caused by distention. This is also true in a case of subcutaneous injection of cocaine.

Blocking of the right splanchnic nerve with procaine or alcohol under direct vision produces results equivalent to right splanchnic section.

Distention of the ducts causes changes in the blood pressure and heart rate but these changes are not uniform. We believe that the reaction of the cardiovascular system to distention of the biliary passages is dependent upon the functional condition of the cardiovascular system at the time the distention occurs.

It was found that intermittent distention of the biliary ducts over a period of 1 week caused decided dilatation of them. It is further observed that during the respiratory inhibition caused by distention the right side of the diaphragm was contracted apparently to serve as a splint.

#### REFERENCES

1. RODENSTAB W. H. J. Am. M. Ass. 1918 lxxi 1
2. CRILE G. W. Keen's Surgery 1912 1 86 Philadelphia W. B. Saunders Company 1912 1 86
3. DE TAKATS Surg. Gynec. & Obst. 192 xlv 501
4. HUBENY M. J. Am. J. Roentgenol. 1916 iii 36
5. HUGHES E. C. Guy's Hosp. Gaz. 1917 xvi 99
6. KAST and MELTZER. Med. Rec. 1906 Dec 29
7. KLEITMAN. Am. J. Physiol. 1922 lx 203
8. POTTENCER F. M. J. Am. M. Ass. 1918 lxxi 507
9. SALE L. J. Am. M. Ass. 1918 lxxi 505

## CARDIOVASCULAR COMPLICATIONS AND THEIR RELATION TO SURGERY<sup>1</sup>

By LEONARD G. POWNTREE, M.D., MINNEAPOLIS, MINNESOTA  
F m th D f M d M y Cl i Th M y F d t

THE more I see of the practice of medicine the more I admire the healing power of Nature but while my respect for the old time galenicals is diminishing my respect for judicious surgery is becoming more profound To me the lack of adequate correlation between medicine and surgery seems deplorable We medical men and surgeons are doing our utmost but too often independently After all we can only offer assistance in the natural processes of healing Our combined resources are often meager enough and should always be pooled for the benefit of the patient There should be no conflict of interest between medicine and surgery for both are aiming at a common end

Most diseases are self limited—cured by Nature and hers are the secrets that we must learn How does Nature induce a crisis in pneumonia establish immunity to childhood diseases cause migraine to disappear in later life control infection stop hemorrhage heal ulcers and arrest the progress of tuberculosis? How does she establish immunity against typhoid fever? Our partial solution of these secrets has unquestionably saved the lives of hundreds of thousands during the last two decades and further discoveries will make possible prevention and cure of disease such as is undreamed of in our philosophy Chronic disease represents Nature's failure to effect cure By knowing her methods and by forethought we can prevent disease and by intelligent aid cure it

What is wrong with drug therapy Chiefly its limitation and its narrow scope Under certain conditions certain amounts of certain drugs will produce certain effects for certain lengths of time The duration of the action is usually short and the element of time is therefore important If sodium nitrite succeeds in lowering blood pressure for 1 or 2 hours what innumerable doses are taken when the treatment is continued throughout a period of 10 or 15 years<sup>1</sup> Or take another

example familiar to all of us If sodium bicarbonate relieves the distress of chronic peptic ulcer think of the amount of soda consumed in the course of 10 years! Ingenious physicians should be capable of devising a better regimen than this But the surgeon replies Ah ha! we do better than that we do a gastro enterostomy and thereby permit healing to take place Yes but what of hypertension? What does the surgeon do for it? Absolutely nothing Having nothing to suggest he calls this a medical disease but his attitude is not justifiable Eventually surgery may be able to offer more than medicine does for hypertension At least the surgeon should retain a working interest in this field

Drugs are valuable of course Anesthetics and antiseptics are indispensable even to surgery in fact they have made modern surgery possible Others are life saving and health giving specific remedies drugs that relieve distressing symptoms and tide the patient over a crisis until Nature has had her chance drugs that supply specific deficiencies when Nature has failed to produce a sufficient amount of her own products Medicinal treatment is most potent when it most closely simulates Nature Recently this has meant the utilization of animal products as well as plant products Even when we have secured the suitable products we still must learn Nature's secret of supplying them to the body The discovery of insulin was the greatest triumph of modern medicine but this valuable substance is administered through a hypodermic needle a crude method compared with Nature's

I have already acknowledged my growing respect for surgery which in the face of great risks in certain conditions undertakes to remove certain offending agents substances tissues or organs in the endeavor to effect a cure The results as a rule are more quickly realized and are more lasting than those

derived from medical treatment. However surgery also has its limitations. When structure are removed the body is deprived of the parts and frequently certain processes are not re-established. Surgery is of use only in certain fields. Its greatest success depends on the removal of the seat of disease in organ or a part of an organ or on the readjustment of mechanical factors. As a rule it is incapable of supplying the demand if underfunction exists unless underfunction results from mechanical obstruction.

The surgeon having attained a certain degree of success may be tempted to overemphasize the value of his own work and sometimes to overlook material assistance which the physician or the laboratory can contribute. The viewpoint of the surgeon is mechanical organic and anatomical that of the physician is functional physiological and chemical. Each viewpoint is important but not paramount. We are all equally guilty all worshippers of Bial surgeons at the altar of surgical technique and physicians at the altar of clinical and laboratory examinations and drug therapy. There is need of better team work of closer association in the treatment and investigation of disease. In the realm of surgical practice closer co-operation must depend on the surgeon since such co-operation can be developed only at the invitation of the surgeon. Otherwise the physician lacks the opportunity, no matter how eager he may be to participate in the solution of problems involved in surgery.

According to the latest mortality statistics the most frequent messenger of death is heart disease consequently it is a complication which must be daily considered in surgery. From the standpoint of physician and surgeon alike diagnosis in this field is fairly accurate. Our ideas concerning prognosis are not so well defined. But since the prognosis in cardiac disease is of vital importance in both the therapeutic effect and the risk of the operation it merits consideration by every surgeon. Information is derived largely from three sources the symptoms the local and general signs and the laboratory data. Experience from both the medical and surgical sides is obviously important.

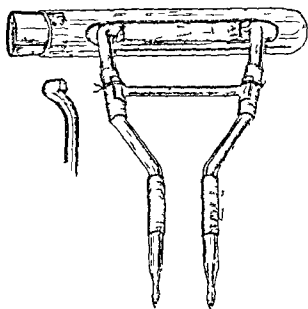


Fig 1 Extra orporeal loop

# CARDIAC DILATION

CASE 1. The patient was an elderly woman with prolapse of the uterus which has existed since the birth of her seventh and last child 20 years previously. She had suffered from frequent colds marked dyspnoea at times and considerable oedema.

On examination the heart was found to be very large measuring 17 centimeters in width. A diagnosis was made of chronic myocarditis and hypertension and an electrocardiogram revealed the T wave to be diphasic in leads I and II. Treatment consisting of rest, digitalis and theocin for the support of the heart and the control of the oedema, a turpene hydrate mixture for the cough and sodium nitrate for the control of hypertension was prescribed.

Although the patient is now free from oedema she still has dyspnoea which is quite marked even when she is resting. The heart is still greatly enlarged the systolic blood pressure is 220 and the diastolic 110 and surgical risk continues to be unfavorable. Inasmuch as her health does not permit her to be up and about and since the prolapse takes care of itself while she is in the prone position I concur in the opinion that surgical procedure is for the present unnecessary.

The second case<sup>1</sup> is one selected from the service of H. S. Plummer who has contributed so largely to our knowledge of diseases of the thyroid and who is likewise a pioneer in the field of the medical management of surgical diseases.

I m h a s t h t h s e p e t d i D t t h d C g i  
be g h y t p t t t t h b j e c t n d d s c C g i  
q e n t l y I m p n t g h b i k t h f e l e c t d e s f m t h  
e c d s d t h M y C l e

TABLE I—GRAVITY OF VARIOUS CARDIOVASCULAR DISEASES FROM THE MEDICAL POINT OF VIEW ACCORDING TO RISK.

Cl ltyp	G vity f ( l k d )	F b s p bly
My c d l ffcency c d c d com p sat n	4 t 3	Dysp æ ord m cya p po t th py g f patie t d my c d l d m g
P cad ts wth eff on espe lly f purul t		Deg e f p d ff t f d a e
Mal n thype t		L f y p t y ( er es b t y ) t l b l d d l d ce ( mpo t nt)
C ro ary scl ro s ( dol )		D tr of d ab lty d my d l damage a sh wn by lect d gram ( t 4 p c t f h case o looked by phys )
Coro ry scl v th ( a g p t )		D g of d b lty l a d my d l d m
Syphul t t t m		P enos g d med t eatm t a l g
Cereb l t cle s c d o le cle of l d e y		Imp m t of f t a d stru t l j ry g f patie t ( m d ff sl t t l b y d t )
Val ul d e c l g e d h a t	3 t 2	R p se t th py and deg of f ct l d stru t ral mp rm t ( R t may st f t )
Low blo d p es st t hyp t n yst l p 95 mm o l		S bject t p top at mpl t n ld b j cts
Scle t c d ase of t em t w th o t g s		P b lty f d bete ( t d c t u l art l f i e cy ts)
P c d t h o adhe e fib u		Re p to th py my d l tat ( o dyl t f l t pe ca d t )
Periphe l s l r d R yn d d se B rg s d s e	t	L w bl d p e k lly m d t pulm ry emb l t b r d
V l u l a r h e t d with n rm l h t		Ag d my d l t t
Be g hyp te n		Ag f p st t t c t l d f to l ump rment

CASE 2 A married woman 51 years of age had suffered from xophthalmic glaucoma for 2 years or more. Her weight had dropped 15 lb from 165 to 150 pounds. Auricular fibrillation had been present for 6 months. The basal metolism was +6.

The patient was placed in the hospital and given Lugol's solution 5 min 4 times a day. The first 5 days the after noon pulse was 50 to 60 on the 5th day it was 98 and the basal metabolism was +39. The pulse rate during the convalescence was from 70 to 85. On the ninth day thyroidectomy was performed. The fourth day after the operation auricular fibrillation appeared and lasted for 4 hours.

With all due respect to the surgical procedure the results in this case were due as much to the medical treatment as to the excellence of the operation. It is interesting to note that the patient's abnormalities all responded markedly to iodine that digitalis

was not employed and that the patient stood the operation successfully despite the fibrillation which might have been considered as a serious contra indication.

In connection with this paper I have felt that it might prove helpful to bring together in a simple way certain medical conceptions concerning the gravity of the outlook in various cardiac diseases together with the surgical risk as we see it from a medical point of view. I have also indicated in a general way the medical treatment. In Table I the diseases are grouped according to the gravity of the outlook from a medical viewpoint while in Table II the various types of arrhythmia are considered.

The electrocardiograph is important in the consideration of surgical procedure because

TABLE II—IMPORTANCE OF ARRHYTHMIA IN DISEASE AND SURGERY

Type of rhythm	Frequency of look		Treatment
	Mortality	(percentage)	
Extra systoles	No valid risk factor	1 to 0	Assurance bromides quinidine
Paroxysmal tachycardia	No valid risk factor	1 to 0	Assurance pressure on various quinidine
Heart block (Complete bundle branch)	Complete block within 11 years	4 to 3	Restriction of activities digitalis care of peculiar manifestations
(Incomplete bundle branch)	Some heart block	3 to 2	
Delayed A-V conduction	Great if rhythm is great if function	4	Atropine determines its nature
Complete heart block	Great	4	Thyroid extract barium chloride digitalis
Auricular flutter	10 to 50 per cent fatal within year	3 to	Rest digitalis quinidine
Auricular fibrillation	40 per cent fatal within 15 months	3 to	Pest digitalis except in the presence of hyperthyroidism

it furnishes information of greater prognostic significance. Striking statistical studies in this field have been carried on by Wilhous. T wave negativity is of great significance prognostically and of still greater significance when aberrant ventricular complexes are superimposed. The importance of this is apparent from a study of Table III. Wilhous has found that 90 per cent of patients with T wave negativity have coronary sclerosis or very large hearts (500 grams or more) excessive enlargement of the heart and coronary sclerosis both indicate a very bad prognosis.

Relative to general prognosis in cardiac disease it is important to determine the incidence of cardiovascular disease from death following operation. I shall present an analysis of the cause of death following laparotomy in 198 cases which is compiled by Robertson from the records of the Mayo Clinic for 1926. It will be seen that pulmonary embolism hemorrhage and cardiac disease taken as a group account for about 20 per cent of the surgical fatalities in this series (Table IV).

I shall discuss a few of the more important factors causing postoperative death particularly from the standpoint of the physician's interest and of the advantage of team work. Of necessity I must confine myself to work

with which I am familiar and hence will discuss chiefly studies carried on in the wards and laboratories of my service.

#### PULMONARY EMBOLISM

In the Mayo Clinic pulmonary embolism accounted for 9.6 per cent of the deaths after laparotomy in 1926 more than 6 per cent of the postoperative deaths during the last 10 years and for more than 7 per cent of the total postoperative deaths during the history of the clinic. The following case is typical.

CASE 3. A woman 58 years of age from the West End came to the Mayo Clinic in August 1927 because of a pelvic tumor. Menstruation had ceased 2 years before since then there had been a constant yellowish discharge. Three months previously severe menorrhagia appeared and lasted for 1 week. After that slight bleeding had occurred when the patient walked. At physical examination the patient appeared normal and healthy. The cervix was small and a large hard tumor was continuous with it. A diagnosis of uterine fibromyoma was made and on August 11 a subtotal abdominal hysterectomy bilateral salpingectomy and oophorectomy were performed for multiple fibromyomata of the uterus bilateral cystic oophoritis and salpingitis. The patient did well until the eleventh day. She was sitting in a chair when she suddenly became dyspneic and cyanotic and died within half an hour. Necropsy revealed pulmonary embolism probably originating in the left iliac vein. There appeared to be no other cause of death.



TABLE III—ELECTROCARDIOGRAM IN PROGNOSIS

T	s t t y	G y f t l k		T t m t
		M d l	S eal (gr d)	
In lead I d II		60 per cent dead	4 to 3	Re t d t c
I II III		w t h r y e r		t n
L ad II nd III		30 p r c e t d d		Ca f m y ca
		w t h r y e a		d u m
W t h add t n l		86 p t d d	4	
b r t Q R		w t h n y e a		
S				

As a result of the all too frequent occurrence of pulmonary embolism a group of us have become interested in the disease with the hope of finding some method of preventing it or at least of lowering its incidence. A method has been devised for the study of vivithrombosis in an extracorporeal circulatory loop. Figure 1 shows a little apparatus which can be attached to the carotid artery and jugular vein of the rabbit so that the blood will circulate through it. The glass parts of the apparatus are connected peripherally by a collodion tube which permits of dialysis. This tube is immersed in a solution of sodium chloride if desired or in any solution of any drug or substance capable of permeating the blood stream by means of dialysis. This method affords an unusual degree of control of physical physiological pharmacological and pathological factors and by its use we hope to be able to throw additional light on the subjects of thrombosis clotting of blood and indirectly perhaps of pulmonary embolism.

Whereas with this apparatus coagulation occurs normally in from 4 to 6 minutes it is delayed many hours by the addition of suitable doses of heparin which according to Howell its discoverer is the normal anti-coagulant present in all normal blood. When heparin is used white thrombi are deposited on the surface in the course of an hour despite the fact that fibrin is not deposited and clotting has not occurred. It is possible therefore by the injection of heparin to control fibrin deposition and when it is given in larger amount and continuously to prevent entirely the deposition of white thrombi. Johnson has been able to show functionally

TABLE IV—IMMEDIATE CAUSES OF DEATH FOLLOWING LAPAROTOMY

	C	P
Pe ton tis	5	37
B h p u m ia	5	2
P l m r y embol m	0	9
O th pulm r y mplicat n	6	3
H am h e		6
Pe t us w t h b o h p e u m n etc	15	7
C d a d as	0	4
C inomat	8	4
H pati d t b c s	9	4
U n a r y d t b s	4	4
I t t ald e	7	3
M ellan	0	4

T : 1

193

active platelets in mammalian blood. The fibrin web as well as the platelets are visible on the collodion membrane. This of course becomes the mesh work of the clotting. In subnormal coagulation such as occurs in jaundice these strings of fibrin are scant or short and apparently ineffective. It is significant that in experimental obstructive jaundice circulation through the apparatus may be maintained for hours and that practically the same conditions can be obtained by the intravenous administration of bile salts.

In a statistical study of records of cases of pulmonary embolism Henderson brought to light the interesting facts (Table V) that the incidence of pulmonary embolism in the Mayo Clinic is approximately the same for operation in the upper and in the lower abdomen. Thus embolism occurred in 75 cases following operations on the stomach gall bladder and bile ducts and in 86 cases following operations on the uterus and its appendages the bladder and the prostate.

But according to the frequency of operations a great difference does exist. Thus the incidence of pulmonary embolism in operations on the stomach and duodenum or on the gall bladder and biliary ducts is approximately 1 in 300 operations; in prostatectomy it is 1 in 200 cases; and in cystostomy preliminary to operation for hypertrophy of the prostate it is 1 in 60 cases. The source of the emboli is obviously important. Table VI shows that the femoral pelvic and prostatic veins are the chief contributors.

Changes occur in the blood subsequent to operation. Allen has made a careful study of

TABLE V—PULMONARY EMBOLISM FOLLOWING INTRA-ABDOMINAL OPERATIONS

Operations	Total	Male	Female
Gall bladder and duct	116	0	31
Stomach	143	0	3
Uterus and appendage	119	1	4
Bladder			
Cystotomy for hypertrophy of prostate	1104	13	1
Prostatectomy	199	11	0
Operation other than simple cystotomy	9	0	4
Colon	2350	0	3
Abdomen			
Exploration	321	1	0
Laparotomy			
Appendix	136	5	0
Kidneys	343	0	0
Rectum	108	5	0
Spleen	317	4	0
Subdiaphragmatic abscess	9	1	4
Omentum (tumor)	2	1	0
Small bowel	991	3	0
Ventral hernia	135	4	0

the blood during the 10 days subsequent to operation. It appears that within a day or after operation there is marked increase in the number of leucocytes and a decrease in the number of erythrocytes and that from the third day on there is a decrease in the total fats of the blood and practically a 100 per cent increase in the fibrin of the blood associated with slight decrease in the coagulation time which is most striking about the sixth day.

Snell has studied the relationship of obesity to fatal postoperative pulmonary embolism and has concluded that there is a group of patients more than 50 years of age obese and with normal or subnormal blood pressure who are particularly susceptible to pulmonary embolism as a postoperative complication. Brown in studying a group of 150 cases of postoperative phlebitis found that although pulmonary infarction was relatively common

TABLE VI—SOURCE OF EMBOLI

	Cases
Iliac vein	64
Femoral vein	55
Pelvic veins	43
Prostatic plexus	18
Vena cava	13
Right auricle	10
Renal vein	
Axillary vein	3
Right ventricle	3
Ovarian veins	3
Hemorrhoidal veins	1
Deep epigastric vein	1
Jugular vein	1
Vaginal plexus	1
Cervical plexus	1
Subclavian vein	1
Innominate vein	1
Azygos vein	1

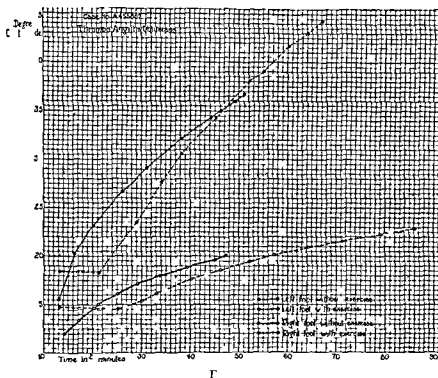
in phlebitis fatal pulmonary embolism was extremely rare. An organism capable of inducing intravascular clotting in animals has been isolated from pulmonary emboli in several instances by Rosenow.

Walters and Coffey have attempted to decrease the incidence of pulmonary embolism by a regimen involving systematic moving of the extremities. Walters has stressed the importance of the vigor of blood flow and has attempted to strengthen the circulation by the administration of desiccated thyroid prior to operation. In his series of more than 5,000 cases there was not a single instance of pulmonary embolism in patients under 70 years of age. Coffey has noted the importance of exercising the legs and breathing deeply.

Sufficient time has not elapsed to allow definite conclusions to be drawn concerning the efficacy of these measures; however the question of pulmonary embolism is one that demands the thoughtful consideration of every surgeon. Pulmonary embolism is always a tragedy; it is always untimely and harrowing to the doctor and to the patient's family. It always appears to be an unnecessary cause of death and is a challenge to our combined forces.

#### HYPERTENSION

Essential hypertension affects surgical risk although in the more benign forms it adds little or nothing to the risk. In fact at times it may even afford a slight factor of safety because it insures a vigorous circulation



F

Malignant hypertension on the other hand is usually fatal within 2 years and consequently entails an extremely grave outlook with or without surgical measures. Minor procedures such as removal of teeth and infected tonsils are hazardous and major operations are unjustifiable except under unusual conditions or when they are undertaken for the relief or cure of the disease itself.

**CASE 4.** A man aged 34 came to the Mayo Clinic chiefly because of headaches and hypertension which had been present 1 year and painless hematuria for 2 weeks. A diagnosis of malignant hypertension was made. The blood pressure and fundus were typical of malignant hypertension. The electrocardiogram confirmed the clinical diagnosis of severe myocardial disease. The T wave became flattened in leads I and II. There was no anemia and the renal function was adequate. Roentgenogram of the kidneys, ureters and bladder negative. Cystoscopic and pyelographic examination satisfactory. The hematuria was apparently of the so-called essential type probably related to the hypertension.

Because of the presence of septic tonsils the fluid pus and in view of the fact that the nasal structure was still good a tonsillectomy was performed. The operation was followed by profuse tonsillar bleeding with the formation of a large hematoma in one tonsillar fossa. The patient was extremely ill for

more than a week. Fever was as high as 100 degrees F on the fifth day after operation. Recovery appeared doubtful. Following tonsillectomy the hemoglobin dropped to 45 per cent (Dare) and erythrocytes to 3,300,000. Recovery was gradual. The patient was dismissed about 2 weeks after the operation. He died at home 13 months later from apoplexy.

In the diagnosis of hypertension and vascular disease information of great value can be derived from the study of the eye grounds and the capillaries. The fundus is diagnostically the polished surface that takes the finger prints of disease and prognostically is Belshazzar's wall whereon the fate of the patient is frequently written. No other structure of the body of like size affords so much pathognomonic evidence. The convenient electric ophthalmoscope removes the last excuse that any physician or surgeon might have for neglecting the fundus examination in cases of vascular disease.

Because of Lombard's investigations the capillaries of the nail fold can now be readily studied. They afford valuable information at times concerning the existence of changes in the capillaries or the body as a whole.

Hæmorrhage from the capillaries a familiar observation in the fundus of the eye in nephritis can often be seen in the nail folds. These capillaries have been studied for several years by Brown and Sheard and may now be photographed.

What is the cause of death in hypertension? Table VII shows the outcome in a series of cases studied by the late Theodore Jeweway who was in his time perhaps the outstanding student of this subject in America. According to him the most frequent causes of death were cardiac insufficiency, uræmia, cerebral apoplexy and angina pectoris. Keith, Wagener and Kernohan found that in malignant hypertension cerebral accident was responsible for death in about a third of the cases and that general cardiorenal failure with œdema of the lungs constituted the most frequent terminal picture.

I am of the opinion although I have little proof that hypertension in the early stages might be better treated surgically than along the medical lines now employed. A recent case of intermittent paroxysmal hypertension reported by C. H. Mayo is fertile in suggestions. This hypertension malignant in character was caused by a peculiar tumor in the region of the left suprarenal gland. The removal of a growth probably of the splanchnic sympathetic nerve brought about immediate and to date permanent cure. In another case of malignant hypertension the greatest symptomatic relief that I have ever witnessed was the result of lumbar sympathetic ganglionectomy performed by Adson. The patient a chronic invalid was restored to almost complete health and returned to full time work at his previous occupation for a period of 15 months. I have been unable to learn the exact cause of death. The idea I wish to convey is that the surgeon should not look on hypertension as a medical disease but should make certain that he is not overlooking an unusual opportunity for the control of one of the most common and serious diseases.

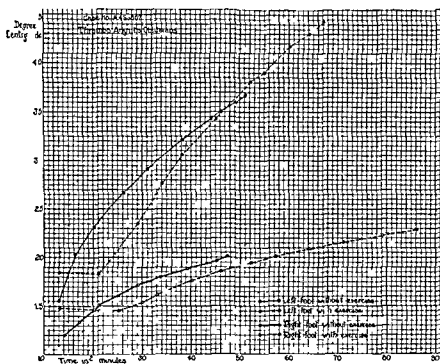
#### PERIPHERAL VASCULAR DISEASE

Peripheral vascular disease constitutes another field which co-operative studies illuminate. Brown and Adson are clarifying our

TABLE VII

Cause of death	M	F	M	F	Total
Gradual cardiac insufficiency	48	35	0	12	25
Uremic convulsions, coma or gradual uræmia	31	22	6	15	31
Cerebral apoplexy or its results	20	14	6	9	19
Angina pectoris	10	7	3		10
Œdema of lungs	6	4	4	1	1
Progressive anæmia	1	0	7	2	4
Pericarditis	1	0	7		3
Complicating acute infectious disease	9	6	6	4	8
Other accidental causes	7	5	1	2	4
Unknown	25			3	
Sudden	4	9			4
Total	162			50	1

conceptions of the cause and nature of pain in the peripheral vascular diseases and incidentally are attempting to save extremities which would heretofore have been sacrificed by amputation. Brown has measured by the foot calorimeter the heat transferred from the extremity and has also studied the surface temperature of the extremity before and after surgical procedures—sympathetic neurectomy and ganglionectomy—carried out by Adson. He has shown in many instances a marked increase in the elimination of heat from the extremity after operation sometimes amounting to 200 or 300 per cent invariably accompanied by an increase in local temperature. Pain has been satisfactorily controlled in many instances. Raynaud's disease of the foot has been practically cured in several instances and excellent results have been obtained in 7 of the 9 cases of Buerger's disease in which lumbar sympathetic neurectomy was performed which shows the typical change in the elimination of heat before and after operation in suitable cases (Fig. 2). In Case 5, amputation seemed unavoidable but complete healing followed sympathetic neurectomy and satisfactory conditions obtained at least for a year. Healing may be accelerated by the use of vaccines. In our experience the greatest relief from this type of pain has followed the intravenous use of vaccines or radium salts.



Fig

Malignant hypertension on the other hand is usually fatal within 2 years and consequently entails an extremely grave outlook with or without surgical measures. Minor processes such as removal of teeth and infected tonsils are hazardous and major operations are unjustifiable except under unusual conditions or when they are undertaken for the relief or cure of the disease itself.

**CASE 4.** A man aged 34 came to the Mayo Clinic chiefly because of headaches and hypertension which had been present for 7 years and painless hematuria for 10 years. A diagnosis of malignant hypertension was made. The blood pressure and fundus were typical of malignant hypertension. The electrocardiogram confirmed the clinical diagnosis of severe myocardial disease, the T wave being inverted in leads I and II. There was no anemia and the renal function was adequate. Roentgenograms of the kidneys, ureters and bladder were negative. Cystoscopic and pyelographic examinations were negative. The hematuria was apparently of the so-called essential type probably related to the hypertension.

Because of the presence of septic tonsil with fluid pus and in view of the fact that the renal status was still good a tonsillectomy was performed. The operation was followed by profuse tonsillar bleeding with the formation of a large hematoma in one tonsillar fossa. The patient was extremely ill for

more than a week before it rose as high as 102 degrees F on the fifth day after operation. Recovery appeared doubtful. Following a splenectomy the hemoglobin dropped to 45 per cent (Darby) and erythrocytes to 3,300. Recovery was gradual. The patient was dismissed about 2 weeks after the operation. He died at home 13 months later from apoplexy.

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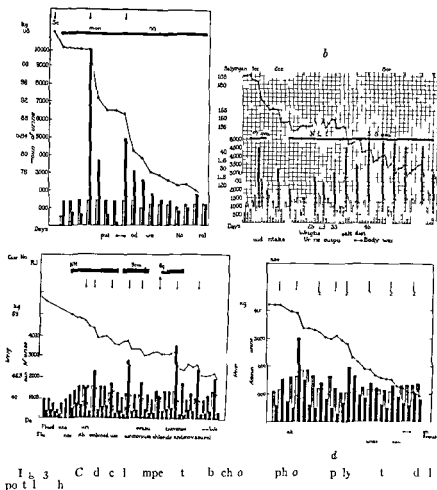
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Brown has established a new criterion for operability in such cases based on the amount of increase in local temperature of the foot following the induction of fever by vaccines. In unsuitable cases there is no increase in peripheral temperature. This promises to be a practical clinical test of decided surgical value.

CASE 5 This is a case of thromboangitis obliterans involving both lower extremities. A patient, aged 54 years, a traveling salesman, came to the Mayo Clinic complaining of pain in both feet, palmar arch, and gait. The pain could be entirely relieved by rest but would return after the patient walked blocks. Examination of the extremities showed in both legs intermittent or quiescent pulsations in the posterior tibial and distal peroneal arteries. Both popliteal arteries showed pulsations and all pulsations were present in the lower extremities. With elevation there was a loss of color after the intense rubor occasioned by leaving both feet in the dependent position for 3 minutes. Early typical changes appeared in the right great toe. Necrosis of the distal phalanx of the right great toe occurred.

A diagnosis of thromboangitis obliterans (Bergstrom) made. Blatant lumbar sympathectomy was performed. Following the operation the palpable temperature of the foot increased. In the right great toe with the thermocouple method a decrease from 41.2 to 40.4 degrees Celsius. The temperature of the distal phalanx of the right great toe decreased from 38.8 to 38.4 degrees Celsius. The patient had a slight decrease in the foot-lorimeter before operation on the right foot. The patient decreased from 0.4 cal/cm<sup>2</sup> to 0.3 cal/cm<sup>2</sup> after operation. The patient decreased from 0.69 cal/cm<sup>2</sup> to 0.57 cal/cm<sup>2</sup>. The patient decreased from 0.70 cal/cm<sup>2</sup> to 0.57 cal/cm<sup>2</sup>. When the patient returned a year later the limb appeared apparently progressed no further. The patient remained healthy. The only symptom was a sensation of fatigue across the base of the toes after walking 405 blocks.

# RENAL INSUFFICIENCY AND SURGICAL RISK

Renal insufficiency is not included in the scope of this paper except insofar as it is the result of renal arterio-sclerosis. Functional tests have developed to such a high degree of accuracy that it is now possible in either medical or surgical lesions of the kidney to determine the function of the kidney adequately and this determination may constitute the basis for surgical judgment. It should be remembered that the content of urea in the blood may be controlled at times by diet but the fixed nature of the blood creatinine constitute to my mind at least the best prognostic indication relative to renal insufficiency. The phenolsulphonphthalein test on the other hand is probably the most practical and reliable for general use.

## SHOCK AND GUM ACACIA

Hypotension rarely causes great concern prior to operation but is frequently important subsequent to operation especially in shock. During the World War shock was studied intensively. Among other things the value of gum acacia in treatment was established by Bayliss Keith who worked on shock in the British medical service during the War has continued his interest in this problem as a result gum acacia is being used at the Mayo Clinic in postoperative shock. The work has been carried on by Huffman who states

In 50 cases of severe postoperative shock marked improvement followed the intravenous use of gum acacia saline solutions. In a number of instances blood transfusion was also used both before and after the acacia. The improvement in pulse and blood pressure seemed no greater if as great when compared to the acacia infusion. In shock accompanying hæmorrhage the use of the acacia solution will remedy the immediate conditions and permit the replacement of the hæmoglobin in a more leisurely fashion or even make transfusion unnecessary. A typical case report follows

CASE 6. A woman aged 47 came to the clinic because of a large tumor in the lower part of the abdomen which had been present for 3 months and was rapidly increasing in size. There had been a loss of weight of about 20 pounds. Hæmoglobin

was 50 per cent. It was believed that the tumor was malignant. At operation a large diffuse fibrosarcoma was found arising from the posterior surface of the uterus. It was widely adherent so that much trauma and considerable loss of blood from oozing surfaces occurred. A profound state of shock supervened evidenced by rapid feeble pulse, cyanosis, rapid respiration and a blood pressure too low to determine with certainty. At this time administration of 6 per cent gum acacia in a solution of sodium chloride was started intravenously. Before 300 cubic centimeters had been given the blood pressure had increased to 80 systolic and 60 diastolic and by the time the injection of 750 cubic centimeters was completed the systolic blood pressure was 110 and the diastolic 70, the pulse was slower and full and the yawning practically gone. The improvement was subsequently maintained and the patient made a splendid recovery from the operation.

## THE OXYGEN TENT IN THE TREATMENT OF PNEUMONIA

As already indicated bronchopneumonia and other pulmonary complications account for approximately 15 per cent of the postoperative mortality at the Mayo Clinic. Oxygen treatment has been accorded a trial in pneumonia during the last 2 or 3 years. The work of Barach, Binger and Stadie and Boothby and his colleagues with the oxygen chamber has shown that in the course of a year a number of lives can apparently be saved by oxygen treatment. Binger and Wilder of the medical staff of the Mayo Clinic have been collaborating with Judd and other members of the surgical staff in utilizing the oxygen tent in all postoperative cases in which there is cyanosis, bronchopneumonia or capillary bronchitis and in a small proportion of the cases in which the postoperative course is febrile. The disappearance of cyanosis under medical treatment is striking. The almost immediate decrease in temperature which occurs in practically all cases is marked and so far unexplained. Our data thus far do not permit of a definite statement how ever the surgeons have encouraged further development of this work, the provision of several machines and a specially trained personnel.

CASE 7. A man aged 28 came to the Mayo Clinic early in January 1927 giving a history typical of peptic ulcer that had existed for years. Because of frequent hæmorrhage operation was advised and



a posterior gastro enterostomy and appendectomy were performed on January 11. On the same day the temperature rose to 102.5 degrees and the pulse to 120. January 12 bilateral postoperative pneumonia was present with dullness on percussion rales at both bases and bronchial breathing. The roentgen ray examination showed infiltration of both lower lobes. Blood culture was negative. The sputum contained streptococcus hæmolyticus but not pneumococcus. The prognosis was grave. The oxygen tent was employed and within 6 hours the temperature, cyanosis and pulse responded but the oxygen was continued for 10 hours longer. There was a mild recurrence 8 days later and oxygen was administered for 6 hours on each of 2 days. The patient recovered completely and was dismissed January 24.

#### THE CONTROL OF ŒDEMA

Generalized œdema is almost invariably of serious import. Recently our ability to cope with this complication has been considerably enhanced. Merbaphen (novasurol salyrgan) has been used in Europe for several years in the treatment of cardiac œdema. Recently we have been utilizing merbaphen in almost all forms of œdema. Keith and I found that it was almost as specific in ascites secondary to portal cirrhosis and Banti's disease. Keith and his associates have still further increased its value by administering ammonium chloride or ammonium nitrate orally at the same time. Figure 3 shows the effects of merbaphen and of these combined diuretics in 4 types of œdema associated with cardiac disease, nephritis, portal cirrhosis and polyserositis. These results are not only of value because of the therapeutic triumph involved but because they throw some light on the mechanism of the production and on the nature of œdema. Irrespective of the organ primarily responsible for the œdema physicochemical changes effected by means of merbaphen have resulted

in its disappearance. The use of the combined diuretics has yielded the most satisfactory results that I have ever encountered in the management of œdema. It removes the necessity for paracentesis in many instances and also for omentopexy. It constitutes at times a medical tapping.

#### PREVENTION OF CARDIOVASCULAR DISTASTES BY SURGICAL MEANS

In the general discussion of the cardiovascular complications it is but fair to add that surgery in itself is valuable in the prevention of the development of cardiovascular disease. The early removal of infected tonsils has probably saved hundreds of thousands of heart from the ravages of rheumatism or other forms of infection. The proper care and when necessary the removal of infected teeth have probably been a great safeguard against subacute bacterial endocarditis. The removal of a hyperfunctioning adenomatous thyroid gland protects the heart against the effects of hyperthyroidism.

The best surgery may profit from contact with good medicine. As a matter of fact under ideal conditions the pre-operative and postoperative care of the patient may be handled best by the intelligent co-operation of medicine and surgery. So strongly are we convinced of this that several combined medical and surgical services have been established in our hospitals. For success the spirit must be right. It demands mutual understanding, mutual sympathy and mutual confidence. Team work is essential to optimal results in surgery. All this can come only on the invitation of the surgeon. The future of this movement rests largely in his hands.

JUVENILE EXOPHTHALMIC GOITER<sup>1</sup>

BY ALTHEA B. MCCLAW, M.D., DETROIT, MICHIGAN  
J. m. c. l. 1 D. fth H. 3 E. 1 H. p. 1

**D**URING the past year we have had the good fortune to encounter two typical cases of juvenile exophthalmic goiter and in view of the recent report of Dinmore and Helmholz we have been led to place the cases on record and review as much of the literature pertinent to juvenile exophthalmic goiter as has been accessible to us.

Arbitrarily assuming that the term juvenile includes all patients under 1 year of age we have found in addition to Dinmore and Helmholz's independent case of 46 and 30 cases respectively reports from various countries during the past 75 years of 45 cases. Thirty nine of the cases reports have been seen in the original. The remainder are quoted from Steiner who collected and published 51 cases in 1897 and whose article is the most comprehensive and searching review of the early literature on this subject that we have encountered.

The two new cases we have to report are as follows:

**CASE 1.** Evelyn D., an only child 6 years of age was first seen on December 2, 1926 in the outpatient pediatric division of the Henry Ford Hospital. Both parents were living and well. The child's paternal grandfather was the only member of the immediate family who had had goiter. The child had been a full term 9½ pound baby born spontaneously after a 4 hour labor without any observed birth injuries or prenatal abnormalities. There were no immediate postnatal troubles. She was nursed at breast for only a half month because of the lack of mother's milk. She was then fed cow's milk and water until she was 9 months old. No digestive disturbances occurred and she was never sickly about her food. She was physically normal mentally slightly precocious. As a baby she had always been nervous and her parents thought she was going to have St. Vitus' dance when she was 3 years old as she was very active by day and restless at night. The child developed a light case of pertussis at 3 years of age. She was vaccinated before she came to the hospital.

In the early months of 1926 her parents noticed the presence of tachycardia and a tendency to perspire easily. The patient came down with a severe case of measles about May 1, 1926. Following the

measles a severe cough and occasional vomiting developed and she was taken to the Children's Hospital, Detroit, Michigan for about a month. Restlessness, nervousness and irritability were noted. As she had always been subject to colds and tonsillitis a tonsillectomy and adenoidectomy were performed in a doctor's office under ether anesthesia during June, 1926. She then lost weight in spite of a ravenous appetite. Nervousness, restlessness and tachycardia were aggravated and emotional irritability was noted. She was kept at the Children's Hospital for 8 weeks beginning in July, 1926. Exophthalmos was first noticed during this period and she suffered from otitis media. Beginning in July she was given drops of tincture of iodine in water each day more or less regularly for 3 months. On this therapy she gained a few pounds in weight but otherwise did not improve. During the 2 weeks immediately preceding admission to the clinic all symptoms, especially the exophthalmos, had increased.

**Physical examination.** On admission to the clinic the child weighed 48½ pounds, she was 48½ inches tall, her temperature was 99.8 degrees F., pulse 115, respiration 24. She appeared to be a reasonably well nourished and developed decidedly hyperactive child. The hyperactivity was characterized by the purposeful but useless movements which Lummer emphasizes in contradistinction to the purposeless character of choreiform twitchings. Posture was normal. There was a coarse rapid tremor of hands and arms, slight non-tender swelling of the synovia of the left ankle but no redness. The skin, especially of the hands, was moist. Surface temperature was elevated. Moderate generalized muscular weakness and accelerated fatigability were noted. The knee jerks were hyperactive but the supinator abdominal and pupillary reflexes were relatively normal. There was moderate enlargement of the tonsillar nodes. Exophthalmos was present in moderate degree. The von Graefe, Stellwag and Moebs signs were positive. There was no nystagmus. The examination of the ears was negative. The teeth were normal in number and in good condition. The tonsils and adenoids had been removed. The mucosa was relatively normal. The nose had no obvious obstruction. A rather firm diffuse enlargement of both lobes and isthmus of the thyroid was noted. No tracheal deviation or evidence of tracheal or esophageal pressure was found. There was no disturbance of phonation. There was a slight bruit but no thrill. Examination of the thorax showed equal expansion. No upper mediastinal creased dullness was detected. The lungs were negative to percussion and auscultation. The heart was slightly enlarged to the left. There were no mur-

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#### PREVENTION

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of her three meals by a dietitian and drinks  $1\frac{1}{2}$  quarts of milk daily. On cloudy days she is given graded exposure to the ultraviolet lamp. There is just a suggestion of exophthalmos and a slight lag in the lid movements. There is no tremor. The child is still slightly restless but sleeps and eats well and is slowly gaining in weight. We hope to have her report for observation regularly at 3 month intervals. One year after operation her basal metabolic rate is minus 5 per cent, her general health is good and she appears quite normal as regards thyroid function.

**CASE 2** Dorothy S. 7 years of age was born in West Virginia of Polish parents. On August 12, 1927, she was brought to the pediatric department of the Henry Ford Hospital because of cough, fever and loss of weight for 10 months. Her father and mother were living and well, likewise two sisters aged 13 and 4 years and a brother aged 10 years. No goiter or tuberculosis was known in the immediate family. The child was born March 8, 1919. Delivery was spontaneous at 9 months after one half hour of labor. Postnatal cyanosis lasted for half an hour. The child weighed  $7\frac{1}{2}$  pounds at birth. At 1 year of age the child was able to walk, talk and control the bladder and bowels. She fed herself at 2 years of age. Her school record had been satisfactory. Dentition was normal as to time and number of teeth erupted but there had been numerous caries of both the first and second teeth. The child had otitis media between the ages of 4 and 5 years but not, however, since a tonsillectomy at  $5\frac{1}{2}$  years of age. At 6 years she had German measles and at  $6\frac{1}{2}$  years non-suppurative cervical adenitis. The child's diet and general habits were those of the average poor and rather ignorant family.

About 10 months before admission to the hospital the child had a short attack of low fever and malaise. Since then there had been a progressive loss of weight. In past 3 months she had lost 8 pounds. She had a dry cough, was weak, became tired easily and had headaches and some abdominal pain. She vomited only if given medicine. There was no diarrhea. The eyes had gradually become prominent. She showed an increasing nervousness and a tendency to cry. The mother had noticed the thyroid enlargement but was uncertain as to its duration. An X-ray picture 1 month before was said to have shown the presence of tuberculosis.

**Physical examination.** Patient was a pale, undernourished, wretched looking child with the facies of exophthalmic goiter. She was hyperkinetic, apprehensive and cried easily. Her palms were moist but the skin elsewhere was rather hot and moderately dehydrated. The muscles of the extremities were poorly developed. There were no bony deformities. A fine tremor was noted in the fingers. No choreiform movements were present. The spinal contour was normal. The reflexes were present and slightly hyperactive. Examination of the eyes showed a first degree exophthalmos, lid lag and weak convergence. The maxillaries were cloudy and

there was a mucopurulent discharge and marked irritation and crusting in both nostrils. The examination of the ears was negative. There were numerous dental caries with diffuse enlargement. No thrill or bruit was present. Both sides were about equal in size. The superficial and deep cervical gland showed first degree enlargement. The axillary and inguinal glands were palpable but not enlarged. The heart was not enlarged. The sounds were thudding and there was a short non-transmitted apical systolic murmur. Blood pressure was 110-50. Examination of the abdomen revealed slight gaseous distention of the colon.

**Laboratory findings.** The patient's blood Wassermann was 1 plus (Kahn) and 111.00 (Kolmer). The mother's blood Wassermann was negative; the father's was not available.

The patient's blood count showed hemoglobin 60 per cent, red blood cells 3,900,000, leucocytes 8,850, polymorphonuclears 72 per cent. The urinalysis showed a trace of albumin, a normal Benedict's some mucus and many leucocytes and epithelial cells. The tuberculin test was positive in 16 hours (0 milligrams old tuberculin). The basal metabolic tests were as follows: on August 13, plus 23 per cent on the square meter basis and plus 40 per cent on the kilogram basis; on August 18, plus 16 per cent on the square meter basis and plus 8 per cent on the kilogram basis; on August 30, plus minus 0 on the square meter basis and plus 10 per cent on the kilogram basis. X-ray pictures of the lungs showed enlarged tracheal and bronchial lymph nodes and slight peribronchial thickening but no evidence of pulmonary tuberculosis.

**Treatment.** The child was placed on a regime consisting of continuous rest in bed, restriction of visits, high caloric diet, forced fluids, Lugol's solution 10 minims twice a day by mouth and luminal  $\frac{1}{4}$  grain three times a day after meals. The nasal condition was treated externally with 5 per cent ammoniated mercury ointment and internally by double suction and a 0 per cent argyrol spray. The patient was kept in the hospital for 17 days. Her rectal temperature varied from normal to 100 degrees F. It was more consistently normal during the last 4 or 5 days in the hospital. Her pulse ranged from 105 to 135 during the first 10 days and from 90 to 110 during the remainder of her stay. Her general appearance, appetite, nervousness and the local nasal condition all improved markedly. There was no change in her eyes or in the thyroid gland. A subtotal thyroidectomy was strongly advised but the mother refused to permit the operation and insisted upon taking the child home to West Virginia. We have been unable to trace her since.

#### HISTORICAL

The majority of the 30 cases found in addition to those reported by Dinsmore and Helmholz are isolated examples of juvenile exoph

murs or thrills. The sound were of good quality and regular but rapid. I palpated on the carotids as noted. The examination of the abdomen was negative. The genitalia were normal. Diagnosis exophthalmic goiter.

The child was admitted to the hospital December 1926 for further study, treatment and probable surgical therapy, with general orders for continuous rest in bed, high caloric diet, forced fluids and strict limitation of visitors. The parents were permitted to visit the child for only 1 hour a day. Lugol's solution 5 minims was given daily for 6 days, luminal 3/4 grain each day, later increased to 1 1/2 grains in divided doses as all given.

*Laboratory findings.* Urinalysis showed a specific gravity of 1.006, reaction acid, albumin one, sugar none (Benedict). Microscopic examination was negative. A blood count showed 4,000,000 red blood cells, hemoglobin 80 per cent, leucocytes 7,500, polymorphonuclears 24 per cent, lymphocytes 2 per cent, small mononuclears 7 per cent, large mononuclears 2 per cent. The blood was classed as being in Group IV. Blood Wassermann reaction was negative. Further analysis showed blood sugar 71 milligrams per 100 cubic centimeters, non protein nitrogen 5.2 milligrams per 100 cubic centimeters. The basal metabolic rate of December 3, 1926, was plus 84 per cent. An electrocardiogram showed sinus tachycardia, a moderate left atrial preponderance and moderate electrocardiographic definite evidence of damage to the myocardium. A roentgenogram of the thorax showed slight cardiac enlargement. No enlargement of the thyroid shadow.

In the preoperative period the pulse averaged 130 occasionally reaching 150 or dropping to 110. The temperature ranged from normal to 100.5 degrees Fahrenheit. Respiration was normal. There was practically no improvement in the nervous manifestations. The child slept poorly. A basal metabolism test on December 1 gave a result of plus 65 per cent. At the end of 2 weeks the patient's general condition was slightly improved but not enough to warrant subtotal thyroidectomy so a ligation of the superior thyroid artery was decided upon. The possible adverse effect of a thyroidectomy upon the child's growth was also considered and discussed at this time.

The first operation, December 6, 1926, was performed under ethyl chloride anesthesia. The skin was prepared with mercuric iodine (Scott's solution) and a low collar neck was made. Each superior thyroid artery was ligated. The operation was completed in 5 minutes with a small loss of blood. The pulse as usual of good quality and at a rate of 20 to 140 per minute. The postoperative reaction was good except for slight acidosis which was controlled by glucose saline hypodermoclysis.

Following ligation the pulse continued to average 130 beats per minute for 6 days and on the eighth dropped to an average of 100. The postoperative temperature at 99.5 to 100 degrees. The child

healed by primary union. There was very little clinical improvement. The patient was discharged for over Christmas day to try the effect of rest at home, the parents being carefully instructed as to diet and general care. However within 3 days diarrhea appeared and the patient was brought back to the hospital. Diarrhea was controlled within 24 hours. The pulse and temperature records were practically similar to those made when the child was first admitted, but after 7 days in the hospital a slight but definite decrease in pulse rate commenced. Nervous symptoms were on the increase however and a thyroidectomy was decided upon.

*The second operation.* On January 8, 1927, comprised a subtotal thyroidectomy with removal of the isthmus under ethylene oxygen anesthesia. The skin was prepared with mercurochrome and the previous incision was reopened. The operation required 45 minutes. Each lobe was found to be uniformly enlarged to what was estimated as about four times the normal size of the gland. By far the larger part of each lobe was removed but the effect on the neck was not quite as radical as ordinarily carry out on adults. The pulse was 120 to 130 during the operation and of good quality. Respiration and blood were lost. The postoperative course was better than after the first operation. There was no evidence of acidosis. The patient was able to retain fluids by mouth. For 6 days there was no change in the pulse but thereafter steadily increased. Eye signs were much improved. By the tenth day the fifth and sixth ribs in the patient's chest were charged the pulse gradually dropped to a level of 100 to 110. From January 4 to 20 she had quite a severe headache with some indigestion of the maxillary sinuses but not of the ears. On January 18 deep roentgen ray treatment was given over the thyroid area (0.5 by 10 centimeters) at a focal skin distance of 1 inch for 4 minutes through 3 millimeters of aluminum filter with a current of 70 kilovolts, 5 milliamperes.

Since her discharge from the hospital the patient has gradually but steadily improved. Five weeks after the operation she weighed 55 pounds, pulse was 98, the basal metabolism rate was plus 6 per cent (kilogram basis) plus 16 per cent (surface area basis). There was very slight tremor and xophthalmos and a marked improvement in restlessness and nervousness. After 3 months her weight was 54 1/2 pounds, pulse 74, blood pressure 95-70, basal metabolism rate plus 1 per cent (surface area basis) minus 5 per cent (kilogram basis). There was no tremor or eye signs. Restlessness and nervousness had disappeared. Her appetite was good and she slept well. After 1 month the pulse was 88, blood pressure was 100-60, basal metabolism rate minus 2 per cent (surface area basis) and minus 7 per cent (kilogram basis). The little girl at present, January 1928, under ideal conditions in the outdoor department of a Detroit public school. She is under the supervision of a nurse 15 feet 2

of her three meals by a dietitian and drinks 1 1/2 quarts of milk daily. On cloudy days she is given graded exposure to the ultraviolet lamp. There is just a suggestion of exophthalmos and a slight lag in the lid movements. There is no tremor. The child is still slightly restless but sleeps and eats well and is slowly gaining in weight. We hope to have her report for observation regularly at 3 months intervals. One year after operation her basal metabolic rate is minus 5 per cent, her general health is good and she appears quite normal as regards thyroid function.

**CASE 2** Dorothy S. 7 years of age was born in West Virginia of Polish parents. On August 12, 1927, she was brought to the pediatric department of the Henry Ford Hospital because of cough, fever and loss of weight for 10 months. Her father and mother were living and well, likewise two sisters aged 13 and 4 years and a brother aged 10 years. No goiter or tuberculosis was known in the immediate family. The child was born March 8, 1919. Delivery was spontaneous at 9 months after one half hour of labor. Ictus cyanosis lasted for half an hour. The child weighed 7 1/4 pounds at birth. At 1 year of age the child was able to walk, talk and control the bladder and bowels. She fed herself at 2 years of age. Her school record had been satisfactory. Dentition was normal as to time and number of teeth erupted but there had been numerous caries of both the first and second teeth. The child had otitis media between the ages of 4 and 5 years but not however since a tonsillectomy at 5 1/2 years of age. At 6 years she had German measles and at 6 1/2 years non suppurative cervical adenitis. The child's diet and general habits were those of the average poor and rather ignorant family.

About 10 months before admission to the hospital the child had a short attack of low fever and malaise. Since then there had been a progressive loss of weight. In past 3 months she had lost 8 pounds. She had a dry cough, was weak, became tired easily and had headaches and some abdominal pain. She vomited only if given medicine. There was no diarrhoea. The eyes had gradually become prominent. She showed an increasing nervousness and a tendency to cry. The mother had noticed the thyroid enlargement but was uncertain as to its duration. An X-ray picture 1 month before was said to have shown the presence of tuberculosis.

**Physical examination.** Patient was a pale, undernourished, wretched looking child with the facies of exophthalmic goiter. She was hyperkinetic, apprehensive and cried easily. Her palms were moist but the skin elsewhere was rather hot and moderately dehydrated. The muscles of the extremities were poorly developed. There were no bony deformities. A fine tremor was noted in the fingers. No choreiform movements were present. The spinal contour was normal. The reflexes were present and slightly hyperactive. Examination of the eyes showed a first degree exophthalmos, lid lag and weak convergence. The maxillaries were cloudy and

there was a mucopurulent discharge and marked irritation and crusting in both nostrils. The examination of the ears was negative. There were numerous dental caries with diffuse enlargement. No thrill or bruit was present. Both sides were about equal in size. The superficial and deep cervical gland showed first degree enlargement. The axillary and inguinal glands were palpable but not enlarged. The heart was not enlarged. The sounds were thudding and there was a short non-transmitted typical systolic murmur. Blood pressure was 110-50. Examination of the abdomen revealed slight gaseous distention of the colon.

**Laboratory findings.** The patient's blood Wassermann was 1 plus (Kahn) and 111,000 (Kolmer). The mother's blood Wassermann was negative; the father's was not available.

The patient's blood count showed haemoglobin 60 per cent, red blood cells 3,900,000, leucocytes 9,850, polymorphonuclears 72 per cent. The urinalysis showed a trace of albumin, a normal Benedict's mucus and many leucocytes and epithelial cells. The tuberculin test was positive in 16 hours (20 milligrams old tuberculin). The basal metabolic tests were as follows: on August 13, plus 23 per cent on the square meter basis and plus 40 per cent on the kilogram basis; on August 18, plus 16 per cent on the square meter basis and plus 28 per cent on the kilogram basis; on August 30, plus minus 0 on the square meter basis and plus 10 per cent on the kilogram basis. X-ray pictures of the lungs showed enlarged tracheal and bronchial lymph nodes and slight peribronchial thickening but no evidence of pulmonary tuberculosis.

**Treatment.** The child was placed on a regime consisting of continuous rest in bed, restriction of visitors, high caloric diet, forced fluids, Lugol's solution 10 minims twice a day by mouth and luminal 1/4 grain three times a day after meals. The nasal condition was treated externally with 5 per cent ammoniated mercury ointment and internally by double suction and a 0 per cent argyrol spray. The patient was kept in the hospital for 17 days. Her rectal temperature varied from normal to 100 degrees F. It was more consistently normal during the last 4 or 5 days in the hospital. Her pulse ranged from 105 to 135 during the first 10 days and from 90 to 110 during the remainder of her stay. Her general appearance, appetite, nervousness and the local nasal condition all improved markedly. There was no change in her eyes or in the thyroid gland. A subtotal thyroidectomy was strongly advised but the mother refused to permit the operation and insisted upon taking the child home to West Virginia. We have been unable to trace her since.

#### HISTORICAL

The majority of the 50 cases found in addition to those reported by Dinsmore and Helmholz are isolated examples of juvenile exoph



## CONSTITUTION

Some mention is made of the general type or physical condition of 70 per cent of the children but many of the terms used are too vague to be of much service. A report of good was made in 6 per cent of the cases, undernourished in 3 per cent, anemic in 20 per cent, nervous habitus in 5, per cent, rapid growth in 5 per cent, rachitic in 5 per cent, delicate in 5 per cent, delayed menstruation in 5 per cent, scrofulous in 3 per cent, and asthenic in 3 per cent. Roughly speaking, we can say that exophthalmic goiter appeared in an otherwise healthy, sturdy child in only one fourth of the cases, and second that exanthemata and acute upper respiratory infections probably play the same predisposing role that they do in regard to the acquisition of various other diseases of later childhood.

## SYMPTOMS AND PHYSICAL SIGNS

The four cardinal signs or symptoms of Graves disease are goiter, tachycardia, exophthalmos, and tremor. These may be present in any degree and grouping, and any two or three symptoms may, though rarely, be absent. In 34 of the 50 cases some mention of these cardinal symptoms was made as shown in Table III.

Of the four cardinal symptoms, those relating to the heart have received the most consistently detailed observation. Some *cardiac sign or symptom* is mentioned in each of the 50 case reports. In 5 cases no mention was made of the heart rate. In 1 of the 45 remaining cases normal pulse rate was specified. In 11 cases either tachycardia or palpitation was mentioned, and of the 33 cases in which a pulse rate was reported, none was below 100 beats per minute. It therefore seems reasonable to expect tachycardia in from 90 to 95

per cent of cases of juvenile exophthalmic goiter.

Other cardiac symptoms were mentioned as follows:

Cardiac symptom	Number of cases
Heaving precordial impulse	10
Enlargement of the heart	6
Palpitation cervical veins and arteries	6
Murmurs	22
Weak pulse	12
Accentuated second sound	8
Irrregular pulse	6
Thrills	6
Bruit	4
Heart failure	2

These percentages should be taken only as a general indication of the relative incidence of heart symptoms and signs, because the various observers probably did not note the presence or absence of symptoms with equal care and precision.

*Thyroid enlargement* as might be expected was present in 100 per cent of the cases. In only 1 per cent, however, was the goiter definitely described as a marked enlargement. In 4 per cent it was reported as small. In 30 per cent the right lobe was noted as being larger than the left, in 4 per cent as being smaller.

*Exophthalmos* was reported as present in 96 per cent of the cases, and as marked in 2 per cent. In only 4 cases was reference made to a difference in the degree of exophthalmos in the two eyes. The associated eye signs of lid lag (von Graefe), widened apertures (Stellwag), and weakness of convergence (Moeblus) were mentioned in so few of the reports that to give the percentages would be entirely misleading. In 1 case Gagnon's the exophthalmos was severe enough to produce keratitis and corneal ulcer. This also was 1 of the 2 cases in the series with fatal termination.

*Digestive symptoms* were observed in only a few cases. Vomiting and anorexia were each noted in 4 cases, polyphagia, diarrhoea, and excessive flatus each in 1 case, epigastric pressure in 1 case.

The only *respiratory symptom* mentioned with any frequency was dyspnoea on exertion in 60 per cent of the cases.

Some *nervous or psychic symptom* was mentioned in 7 of the 50 cases, but aside from

TABLE III.—SEQUENCE OF CARDINAL SYMPTOMS

	Goiter	Exophthalmos	Tachycardia	Tremor
1st symptom noticed	9	8	7	3
2nd symptom noticed	6	5	5	0
3rd symptom noticed	8	4	3	2
4th symptom noticed	0		4	



TABLE IV—RESULTS OF DIFFERENT TYPES OF OPERATION

Type	N	mb	C	mpl	D	pp	t	ymp	m	d	P	t	al	N	h	g	W
Lg at n ly																	
P h m n ryl g t n	3																
Double l b t my																	
ft rlg to																	
S gle l b tomy																	
fter l gatio																	
I m ry d ble																	
l bect my	2																
Total p tio s	9																

the report of tremor in 18 irritability in 16 and insomnia in 4 cases there is a surprising lack throughout the whole series of case reports of systematic evaluation of the nervous system. Almost all of the individual signs and symptoms we are accustomed to look for such as restlessness crying fatigability increased reflexes quadriceps weakness etc were mentioned once or perhaps twice but not oftener.

The same indifference characterized the reporting of *skin symptoms* but it is of interest to find vitiligo reported in cases. Both patients were 12 years of age.

In the group of 50 cases which we have been considering the basal metabolic rate has been mentioned only in the 3 cases reported by Heiman and in our 2 case. Helmholtz however in his series of 30 cases gives excellent tables of the pre operative and postoperative metabolic rates. Heiman's 3 cases showed rates of plus 12 per cent plus 0 per cent and plus 5 per cent respectively before operation. Ours showed highest rates of plus 80 per cent and plus 40 per cent.

#### TREATMENT AND ITS RESULTS

Excluding consideration of the series of Dinsmore and Helmholtz definite notes on treatment were given for only 29 cases and of results in only 38 of the 50 cases. Thyroid surgery was resorted to in 9 cases and consisted of a ligation of the superior thyroid arteries alone in 8 cases a single lobectomy preceded by a ligation in 1 case a double lobectomy preceded by a ligation in 1 case a primary single lobectomy in 1 case and a primary double lobectomy in 3 cases. None of these 9 cases was made worse by surgery. 1 case showed no change following ligation

TABLE V—RESULTS OF DIFFERENT TYPES OF MEDICAL TREATMENT

F	m	ft	tm	t	N	f	es	B	t	N	h	g	W
l l t ty													
D h t ls													
Iod													
Ar s n													
P t m l d													
H h lo d t													
T ll t my													
Qu in													
Iro													
V t on													
R t													
Ic b gs													
St l													
L t													

and the 8 others were either partially or wholly improved. A tabulation of operative results is shown in Table IV.

Turning to methods of treatment other than thyroid surgery a large and interesting variety is encountered. Eight cases were treated by some form of electric current all before 1887. The drug most frequently used was digitalis and it was employed in cases reported as early as the 70's. Iodine curiously was used in only 4 of the group of 50 cases including our own but it was doubtless used in many or all of the series of Dinsmore and Helmholtz. Ict likewise was specifically cited in only 1 case but here again it is safe to assume that in nearly all of the 50 cases rest in some degree was employed without perhaps a due appreciation of the large role it was probably playing in the patients' improvement. It is interesting that in 2 cases in which total illectomy was tried as a palliative measure in full knowledge of coexisting hyperthyroidism the resulting condition was worse rather than better. In Table V the various forms of treatment and results obtained are shown. Most of the drugs listed were used in combinations of two or three.

#### SUMMARY AND CONCLUSIONS

In any report of a case or group of cases the late results almost always rank first in fundamental interest and importance. To follow patients and convince them of the value of returning for periodic examinations over a period not only of months but of years is slow and often seemingly thankless work yet

what an invaluable set of data we would have if we could only know the subsequent clinical history of every one of these children and the effects of the early hyperthyroidism! How many of the patients who were not operated upon and have had spontaneous remissions had recurrences in later life and how many of these recurrences were in the form of adenomatous or parenchymatous goiters? Did thyroidectomy have any apparent adverse effect on the growth development fecundity etc of the patients? In one of our own cases we feel that we have enlisted the co operation both of the parents and patient and shall make every effort to continue our observations in order that a subsequent report may be made after a period of years.

In addition to stressing the importance of ascertaining and reporting late results we also wish to urge a certain uniformity in reporting cases is infrequently observed as these and to suggest that the schema of Steiner be used as a framework on which to build such reports so that the early case reports can be included. Certain data such as basal metabolic studies details of operative procedures electrocardiographic studies etc will of course have to be added. Only by pooling our observations of such rare cases as these can we eventually obtain reasonably reliable statistical data to help us form conclusions rather than opinions.

What finally are the opinions we have reached from the observation of our own and the cases we have gathered together from the literature? First juvenile hyperthyroidism is apparently identical in its symptoms course and response to treatment to the adult syndrome known as exophthalmic goiter. Second cases of juvenile hyperthyroidism are in the present state of our knowledge primarily surgical problems and the sequence of events in their care should be rest the administration of iodine operation rest and observation under surgical supervision. Third while we doubt that polar ligation of the superior thyroid arteries is a sufficiently radical procedure to insure a permanent recession of symptoms we feel that one should be a shade more conservative in the relative amount of thyroid tissue left behind at operation as compared

with that left in cases of adult exophthalmic goiter—even risking the necessity of subsequent reoperation until we have some accurate data on the effect of subtotal thyroidectomy upon human growth and development.

## BIBLIOGRAPHY

- 1 BAGINSKY A Lehrbuch der Kinderkrankheiten 1885 p 736
- 2 BALDWIN C Lancet 1895 i 145
- 3 BARRETT C Paris The is 1901
- 4 BOOTH A Ueber die Basal-louische Krankheit Inaugural dissertation Würzburg 1888 p 51
- 5 BOUCHUT Trait<sup>e</sup> Clinique des Maladies des Nouveaux nés 153 p 246 thed p 23
- 6 BURFORD I A J Am M A 1922 xxviii 1533
- 7 CHVOSTEK I O tert Jahrb f Paediat 1905 vi 5
- 8 CROHN Arch f Kinderh 1884 iv 98
- 9 DUMME P Cerhardt's Handb d Kinderkrankh 1905 iii 307 Klin Mittl a d Gebiete d Kinderheilk Bern 1901
- 10 DUNSMORE Surg Gynec & Obst 1926 xlii 1
- 11 DUESCH TH Cerhardt's Handb d Kinderkrankh ii 1 p 396
- 12 EHRLICH H Inaugural dissertation Berlin 1890
- 13 FOERSTER R Berl klin Wchnchr 1890 I
- 14 GAGNON M A Caz hebdom dem d 1896 xxiii 61
- 15 HAWKES J Lancet 1861 ii 131
- 16 HEIMAN H Am J Di Child 1923 xi 16
- 17 HILDSHOLZ J Am M A s 1926 lxxx ii 3
- 18 HIRSCH KAMBER Klinische Wahrnehmungen und Beobachtungen Berlin 1851 p 178
- 19 HOCK Wien med Presse 1895 p 1064
- 20 JACOBI A Am J Obst 1875 June Med Rec N Y 1879 x i 1
- 21 KALM A Inaugural dissertation Goettingen 1883 p 39
- 22 KLEIN Arch I diat 1922 xxxix 786
- 23 KRAUS Wien klin Wchnchr 1891 p 898
- 24 KRONTHAL P Berl klin Wchnchr 1893 xxvii 651
- 5 LEBARRAQUE M Union med 1860 cxlii 435
- 6 LEWIS A Inaugural dissertation Berlin 1888 p 11
- 7 LEWIS W H St Paul M J 1914 xvi 91
- 28 MUELLER H Cor Bl f Schw is Aerzte 1889 xxxv 42
- 9 OCHSNER A J The Surgical Pathology of the Thyroid Cland 1910 p 192
- 30 OPPOLZER Wien med Wchnchr 1866 xlix
- 31 PEPPER Med Rec N Y 1877 xii 545
- 32 PRAEL F SR Arch f Ophth 1857 iii 206
- 33 ROSENBERG Berl klin Wchnchr 1865 i 496
- 34 SATTLER H Arch f Ophth 1909 ix 615
- 35 SAWYER A W Ann Surg 1916 l iv 371
- 36 SCHWENKENDICK Allg med Centr Ztg 1833 l xvi 1082
- 37 SOLBRIG Ztschr f Psychiatrie 1871 xxvii 5
- 38 STEINER F Arch f Kinderh 1897 xx 321
- 39 STOFFELA Wien med Wchnchr 1883 xvi
- 40 SUTTON Brit M J 1878 ii 110
- 41 VARIOT Bull Soc de pèdiat de Par 1901 June p 197
- 42 WEIDEMANN Inaugural dissertation Berlin 1886 p 45
- 43 WHITE C J Obst & Gynec Brit Imp 1912 xxi 231
- 44 ZUEBER Arch de med d enf Par 1900 v 606

## THE SIGNIFICANCE OF MUCUS-FORMING CELLS IN CARCINOMA OF THE LARGE INTESTINE AND RECTUM<sup>1</sup>

BY NOBMAN C. OCHSNIHIT M.D. I. C. ESTER MINN. TA

I II S Th M F d

**M**UCUS is a viscid sticky secretion produced by the goblet cells of mucous membranes and by mucous glands. It is found in almost all cylindrical and cuboidal epithelial membrane such as line the respiratory and gastrointestinal tracts (11) and in the mucous gland of the e tracts in the saliva from the mucous secreting glands of the mouth such as the submaxillary and sublingual glands and the mucous glands of the tongue in the bile from the mucous gland and the goblet cells of the mucous membrane of the large bile ducts in the gall bladder from its mucous gland and in the urine (6).

In the large intestine most of the cell of the epithelial surface and the mucous glands are goblet cells. Mucus is laid down within the cells in the form of granules or globules of mucigen. The granule eventually swell up to form globular mass which clump together and greatly distend the part of the cell nearest the free border and are extruded as mucus. The goblet cells or mucus secreting cells are not mere temporary modifications of the ordinary columnar epithelial cells but are permanently differentiated cell. After discharging their mucus they again form a fresh supply (11).

Bizzozero found that the mucous cells as well as the protoplasmic cells arise from undifferentiated elements but in the embryo only the protoplasmic cell is present the mucous cell arise from a later differentiation.

Sacerdotti found that mucous cells differentiated early in the embryo of a cow. In a 3.5 centimeter fetus he found certain cell groups beginning to form and surround a mucus containing cavity and in a 7 centimeter fetus he found mucous cell in the rectum and a few in the duodenum and ileum.

Baumsky discovered in a 4 month human fetus that there was slight formation of glands in the colon but that the mucous membrane was composed of flat epithelium.

In a 7 month fetus he found well developed glands everywhere and the epithelium cylindrical often changing to the goblet type. Observations concerning the rectum were similar.

Von der Leven did not find goblet cells in which mucus could be demonstrated in the colon of a 27 centimeter fetus but they were numerous and distinct in the newborn and in older children.

By cellular differentiation meant the structural changes which take place in the evolution of an adult tissue cell (7).

The conception that the presence of cellular differentiation is unfavorable to the continued growth of carcinoma cells is based on the unwritten law in general biology that the power of cellular production is inversely proportional to cellular differentiation. If the law is correct carcinoma cells which show partial differentiation must of necessity grow less rapidly than carcinoma cell without differentiation (1).

Robertson states that the appearance of mucus droplets in cell of growths arising from any glandular epithelial structures is a differential characteristic that is quite evident that the mucus producing epithelial cell is a differentiation and growths from these cells retain with exceeding tenacity this particular characterization.

The cell of a neoplasm that show practically no tendency to control themselves rapidly infiltrate the adjacent structure and by utilizing the vascular system as a means of metastasis set up colonies in various parts of the body which in turn keep on producing their own kind of cells finally with fatal result. On the other hand if the cells of a neoplasm show a marked tendency to control themselves by differentiation the neoplasm will grow slowly and show very little tendency to metastasize (3).

Carcinoma that arises from the regenerative cell of gland or secretory epithelium should be termed adenocarcinoma or gland carcinoma.

Ab d m f l b m d h f l y f h G i S h f f h G W k d h D t m so f P h i f f l l m f h q



Fig. 1. Colloid carcinoma of ascending colon graded 4 with mucus formation graded 4. Most of the cells show mucus formation with much mucus along the edge of the acini and distention of the acini with colloid material stain in, lightly with mucus stain *m*. Some darker staining mucus material is suspended in the colloid. The mucus stains red, the remaining tissue blue. Mucicarmine stain, picric and acetic acid fixation.  $\times 60$ .

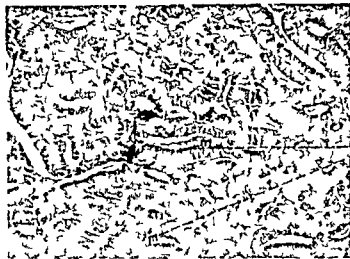


Fig. 2. Section from adenocarcinoma of rectosigmoid graded 2 with mucus formation graded 3. Mucus is seen in many of the cells as large and small globules and also along the free surfaces of the cell and in the acini. Mucicarmine stain, picric and acetic acid fixation.  $\times 60$ .

because whenever differentiation takes place it is usually toward a glandular or secretory type of epithelium. Carcinomas of the large intestine and rectum are nearly always adenocarcinoma with a tendency toward the formation of mucus. The mucus originates in the epithelial cells of the carcinoma. Droplets of mucus are seen arising within the cytoplasm of epithelial cells of the goblet type and in adenocarcinoma mucus is found within the acini. Epithelial cells containing these droplets can practically always be found in the immediate vicinity of extracellular mucus.

In this study sections were made from 188 cases of carcinoma of the large intestine and rectum. The sections were taken from fresh operative specimens and from pathological museum specimens which had been preserved in 10 per cent formalin for from 1 to 30 months. The sections were fixed in alcohol and acetic acid when received at the time of operation and in picric and acetic acids when obtained from the museum. (5) All sections were stained with mucicarmine according to the following technique: (1) fix fresh specimens in alcohol and acetic acid for 24 to 48 hours; fix older specimens (preserved in formalin) in picric and acetic acids for 24 to 48 hours; (2) wash in running tap

water for 24 hours; (3) dehydrate in 80 per cent alcohol for 6 hours; (4) dehydrate in 95 per cent alcohol for 4 hours; (5) dehydrate in absolute alcohol for 6 hours; (6) place in equal parts of toluol and paraffin in an oven at 52 degrees C for 1 hour; (7) embed in paraffin in an oven for 2 hours; (8) cut sections about 8 microns thick; (9) stain with alum hematoxylin for 3 minutes; (10) decolorize with acid alcohol; (11) immerse in an aqueous solution of lithium carbonate for 2 or 3 minutes to bring out the blue color; examine the section under the microscope to determine the depth of the stain at this stage; (12) wash in water; (13) stain with mucicarmine for from 10 to 20 minutes; examine under the microscope to determine the depth of the stain and the length of time of staining necessary to make the differentiation clear; (14) rinse in water; (15) dehydrate in 95 per cent alcohol; (16) clear with acetone for 5 minutes; (17) clear with carbolyxol composed of 1 part of phenol crystals and 3 parts of xylol; (18) clear with xylol and (19) mount in Canada balsam. The mucicarmine stain deteriorates rapidly and must be freshly prepared every few days. It is prepared in the following manner:

A mixture of carmine 1 gram, aluminum chloride 0.5 gram, and distilled water 2 cubic centimeters is heated under a small flame for

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Carcinoma that arises from the regenerative cells of gland or secretory epithelium should be termed adenocarcinoma or gland carcinoma.

Ab d m f h b m d h f l f h C l S h l f h l f M so f f l l l m f h  
m f h d f M f s 7 W k d h D M t f f h l A my



Fig. 1 Colloid carcinoma of ascending colon graded 1 with mucus formation graded 4. Most of the cells show mucus formation with much mucus along the cell walls of the acini and distention of the acini with colloid material stain in lightly with mucus stain. Some darker staining, mucus material is suspended in the colloid. The mucus stains red, the remaining tissue blue. Mucicarmine stain, picric and acetic acid fixation.  $\times 60$ .



Fig. 2 Section from adenocarcinoma of rectosigmoid graded 2 with mucus formation graded 3. Mucus is seen in many of the cells as large and small globules and also along the free surfaces of the cells and in the acini. Mucicarmine stain, picric and acetic acid fixation.  $\times 60$ .

because whenever differentiation takes place it is usually toward a glandular or secretory type of epithelium. Carcinoma of the large intestine and rectum are nearly always adenocarcinoma with a tendency toward the formation of mucus. The mucus originates in the epithelial cells of the carcinoma. Droplets of mucus are seen arising within the cytoplasm of epithelial cells of the goblet type and in adenocarcinoma mucus is found within the acini. Epithelial cells containing these droplets can practically always be found in the immediate vicinity of extracellular mucus.

In this study sections were made from 188 cases of carcinoma of the large intestine and rectum. The sections were taken from fresh operative specimens and from pathological museum specimens which had been preserved in 10 per cent formalin for from 2 to 30 months. The sections were fixed in alcohol and acetic acid when received at the time of operation and in picric and acetic acids when obtained from the museum. (5) All sections were stained with mucicarmine according to the following technique: (1) fix fresh specimens in alcohol and acetic acid for 24 to 48 hours; fix older specimens (preserved in formalin) in picric and acetic acids for 24 to 48 hours; (2) wash in running tap

water for 24 hours; (3) dehydrate in 80 per cent alcohol for 6 hours; (4) dehydrate in 95 per cent alcohol for 4 hours; (5) dehydrate in absolute alcohol for 6 hours; (6) place in equal parts of toluol and paraffin in an oven at 52 degrees C for 1 hour; (7) embed in paraffin in an oven for 4 hours; (8) cut sections about 8 microns thick; (9) stain with alumina hematoxylin for 3 minutes; (10) decolorize with acid alcohol; (11) immerse in an aqueous solution of lithium carbonate for 1 or 3 minutes to bring out the blue color; examine the section under the microscope to determine the depth of the stain at this stage; (12) wash in water; (13) stain with mucicarmine for from 10 to 60 minutes; examine under the microscope to determine the depth of the stain and the length of time of staining necessary to make the differentiation clear; (14) rinse in water; (15) dehydrate in 95 per cent alcohol; (16) clear with acetone for 5 minutes; (17) clear with carbolytol composed of 1 part of phenol crystals and 3 parts of xylol; (18) clear with xylol; and (19) mount in Canada balsam. The mucicarmine stain deteriorates rapidly and must be freshly prepared every few days. It is prepared in the following manner:

A mixture of carmine 1 gram, aluminum chloride 0.5 gram and distilled water 2 cubic centimeters is heated under a small flame for

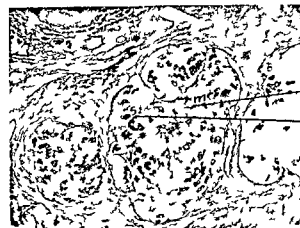


F 3 S t f m d c m f th t m d  
 graded 3 th m f m t g d d h w g m  
 l ge d o p l t th l l a l g the f e f of th  
 c l l th ery l t l th M r m t  
 p c d e t c d f t M t d d  
 m ked diff t t to th t f th t h h t  
 bl X6



Fg 4 S t o f m c m a of th g m d g d d 4  
 vth m s f r m t g d d h v i g m f m t  
 fe l l w h h t a m g l t l M m  
 t l h o l d t d f t M t d  
 t t t th th t X6

minutes and then made up to 100 cubic centimeter with 50 per cent alcohol. It is then ready for use. Mucicarmine stains mucus and mucus containing tissue a vivid red in marked contrast to the surrounding tissue which is stained more or less blue.



F 5 S c t f m c l d c m f the a m  
 g d d d w th m f m t n g d d 4 L a g f  
 o l l d h h t k th m t u n f l y th f  
 typ l m t m t l t t e d th h o t th  
 h w M t f the c l l f th g n t g  
 type s a d f l l d with d n d d w th m  
 wh c t k th typ l c m n e t M c r m t a  
 pic c a d c e t d f i x a t X6

Each case was graded microscopically by Broders according to his method of grading malignancy and a system was devised for the purpose of grading the number of mucus forming cells in carcinoma of the large intestine and rectum (Table I). Mucus was graded 1 when from practically none to 5 per cent of the cells seemed to be involved in the secretion of mucus as evidenced by the mucous globules contained in the cell and the mucus extruded therefrom and lying in the im-

TABLE I—COMPARISON OF THE GRADING OF THE AMOUNT OF MUCUS TO THE MALIGNANCY IN ALL CASES OF CARCINOMA

M l g d	C	f m g d	C se	P
	6	4	6	00
			8	9
				7 4
		3		7
		4		9
			5	6 7
			34	60 6
3	56	3	5	8 9
		4		3 5
				4 3
4	4	4		7 4
				4 3

Fg

TABLE II — COMPARISON OF THE GRADING OF THE AMOUNT OF MUCUS TO THE GRADING OF MALIGNANCY IN COLLOID CARCINOMA

Malignancy grade	Cases	Mucifluent grade	Cases	Percent
1	6	4	6	100.0
	5	3	5	62.5
		4	3	37.5
3	6	3	4	66.6
		4		33.3
4		4	2	100.0

Signet ring type

mediate vicinity of the cells along its free border graded 2 when from 25 to 50 per cent of the cells were producing mucus graded 3 when from 50 to 75 per cent of the cells were producing mucus and graded 4 when from 75 to 100 per cent were producing mucus.

Table I shows that in almost all of the cases the percentage of mucus secreting cells is inversely proportional to the grade of malignancy. This conforms to Broders' basis of grading malignancy on cell differentiation, the formation of the secretion of mucus being evidence of differentiation (Figs. 1 to 4).

The so-called colloid carcinoma is an exception. There were 22 colloid carcinomata in this series (Table II). In the less malignant type of colloid carcinoma there does not seem to be an increase in the number of mucus-forming cells as compared to those found in an adenocarcinoma of the same grade. However, the amount of mucus is increased as the staining indicates. This is probably due to increased activity on the part of the mucus-forming cells. The acini are greatly distended and contain colloid-like material which takes the mucus stain poorly or not at all. This colloid-like material contains small suspended particles which take a typical mucus stain and appear to be true mucus. Wells believes that the mucus of colloid carcinoma of the gastro-intestinal tract is the same as normal mucus from the same source thickened by partial absorption of water from the pressure of retention in a closed cavity and mixed with larger or smaller quantities of other proteins derived from cell degeneration or from vascular exudates. In colloid carcinoma

of the higher grades, especially in those graded 4, mucus seemed to be greatly in excess. Parham found that the signet ring colloid carcinoma was the most malignant type of colloid carcinoma. Such was the case in this series: the only case of signet ring carcinoma were those in which the malignancy was graded 4 (Fig. 5). No goblet cells or cells which resembled the typical mucus-secreting cells were found, yet almost all of the cells were of the signet ring type and were filled with mucus.

## CONCLUSIONS

1. The presence of mucus in carcinoma of the large intestine and rectum is the result of partial differentiation of the carcinoma.

The more malignant the carcinoma or the less the extent of differentiation, the less numerous are the mucus-secreting cells and vice versa.

3. The number of mucus-secreting cells in the carcinoma is inversely proportional to the grade of malignancy.

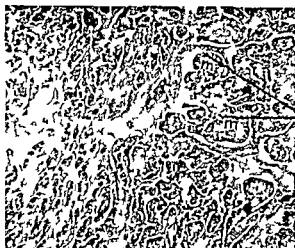
## BIBLIOGRAPHY

1. BACINSKY ADOLF. Untersuchungen ueber den Darmkanal des menschlichen Kindes. Arch f path Anat 1882 lxxix 64-95.
2. BIZZAZZO G. Ueber die schlauchfoermigen Druesen des Ma endarmkanals und die Beziehungen ihres Epithels zu dem Oberflaecheneithel der Schleimhaut. Arch f mikr Anat 1893 xlii 82-152.
3. BRODERS A C. Cancer's self control. Med J & Rec 1925 cxvi 133-135.
4. Idem. The grading of carcinoma. Minnesota Med 1925 viii 7 6-730.
5. KERNOHAN J W. Personal communication.
6. LANDOIS LEONARD and STIRLING WILLIAM. Text book of Human Physiology. 4th ed. Philadelphia: P. Blakiston Son & Co. 1891 pp 244 333 524.
7. MACCARTY W C. Factors which influence longevity in cancer. Ann Surg 1922 lxxvi 9-12.
8. PARHAM DUNCAN. Colloid carcinoma. Ann Surg 1923 lxxvii 90-105.
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10. SICERDOTTI C. Ueber die Entwicklung der Schleimzellen des Magendarmkanals. Internat Monatsschr f Anat u Physiol 1894 ii 501-513.
11. SCHAFER E A S. Essentials of Histology. 11th ed. Philadelphia: Lea & Febiger 1920 p 94.
12. SISTRUNK W E and MACCARTY W C. Life expectancy following radical amputation for carcinoma of the breast: a clinical and pathological study of 218 cases. Ann Surg 1922 lxxv 61-69.
13. VON DER LEYEN ELSE. Ueber die Schleimzone des menschlichen Magen und Darmpithel vor und nach der Geburt. Arch f path Anat 1905 clxxx.
14. WELLS H G. Chemical Pathology. 4th ed. London and Philadelphia: W B Saunders Co. 1920.



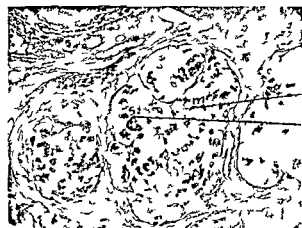


Fg 3 S t f m d m f th e to gm d  
grad d 3 th m f m t g d d h v i g m  
l g d p t t th l l g th f f s f th  
c l l w t r y l t l th c M r m i e t  
p d t a d f t M t d d n  
m k d d f t t t th t f th t h t t  
bl X6



Fg 4 S t n f m m f th e gm d g d d 4  
w th m f m t grad d 1 h w muc f r m t  
f w l l w h t m u g l o b l M c m  
t l h l d t c d 6 t M ta d  
t t t th th t X6

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Fg 3 S t f m l l d m f th e m f  
g d d 4 th m f m t g d d 4 L k f  
l l d h h t k th m t f l l with a e f  
typ c l m u t m t f t t d th h u t th  
s a h w M t f th l l f th g n t g  
type a d t l l d w th d r d d th m g  
h u c h t k th t y p l m t M m u t  
p c c d e t d h t X6

Each case was graded microscopically by Broders according to his method of grading malignancy and a system was devised for the purpose of grading the number of mucus forming cells in carcinoma of the large intestine and rectum (Table I). Mucus was graded 1 when from practically none to 25 per cent of the cells seemed to be involved in the secretion of mucus as evidenced by the mucous globule contained in the cell and the mucus extruded therefrom and lying in the im-

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M 1	Case	M f m d	Cases	P
	7	4	6 1 8	00 9 7 4
		3 4	2 1 5 34	5 9 6 7 60 6
3	6	3 4	5 2	8 9 3 5 4 3
4	4	4		4 4 3

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## BIBLIOGRAPHY

1. BAGINSKY, ADOLF. Untersuchung en ueber den Darmkanal des menschlichen Kindes. Arch. f. path. Anat. 1882, lxxix, 64-95.
2. BIZZAZERO, G. Ueber die schlauchfoermigen Druesen des Magendarmkanals und die Beziehungen ihres Epithels zu dem Oberflaecheneithel der Schleimhaut. Arch. f. mikr. Anat. 1893, xlii, 82-152.
3. BRODERS, A. C. Cancer's self control. Med. J. & Rec. 1925, cxvi, 131-135.
4. Idem. The grading of carcinoma. Minnesota Med. 1925, viii, 7-739.
5. KERNOHAN, J. W. Personal communication.
6. LANDOIS, LEONARD and STIRLING, WILLIAM. Text book of Human Physiology. 4th ed. Philadelphia: P. Blakiston Son & Co. 1891, pp. 244, 333, 524.
7. MACCARTY, W. C. Factors which influence longevity in cancer. Ann. Surg. 1922, lxxv, 9-12.
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10. SACERDOTI, C. Ueber die Entwicklung der Schleimzellen des Magendarmkanals. Internat. Monatsschr. f. Anat. u. Physiol. 1894, ii, 501-513.
11. SCHAFER, E. A. S. Essentials of Histology. 11th ed. Philadelphia: Lea & Febiger. 1920, p. 94.
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14. WELLS, H. G. Chemical Pathology. 4th ed. London and Philadelphia: W. B. Saunders Co. 1920.



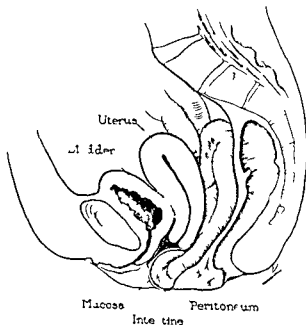


Fig. 1. Longitudinal section through the posterior vaginal wall.

diameter which pushed the posterior vaginal wall forward. The rectum formed part of the mass but when this was pushed back the major portion of the mass remained.

A two stage operation was performed. The abdomen was opened through a low median line incision and the uterus was firmly fixed to the abdominal wall. Appendectomy was also performed. Three weeks later a posterior vaginal flap was dissected high up and the hernial sac isolated and opened. Its contents, loops of the small intestine, the rectum and the sigmoid were replaced in the abdomen. The excess portion of the sac was resected and the opening into the abdomen was closed by a spiral suture. Perineorrhaphy was performed in the usual manner. Convalescence was uneventful. Pelvic examination at the time of dismissal disclosed no bulging of the posterior vaginal wall.

CASE 4. The patient a woman aged 39 had children aged 8 and 10 years respectively. Eight years previous to examination an operation for a supposed prolapse had been performed and the uterus fixed to the anterior abdominal wall. The symptoms recurred as soon as the patient stood up. Since then the condition had become progressively worse and for 4 years a mass had protruded beyond the vulva.

Examination disclosed a complete uterine prolapse and marked cystocele. There was a large mass about 25 centimeters in diameter which pushed the posterior vaginal wall forward and protruded from the vulva. The rectum could be isolated from this mass. A diagnosis of complete uterine prolapse with marked cystocele and rectocele and posterior vaginal hernia was made and an operation was advised. A Mayo vaginal hysterectomy was performed and both tubes and the left ovary were

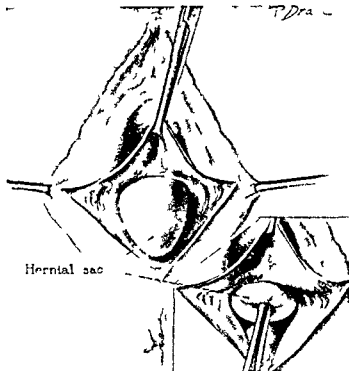


Fig. 2. Hernial sac as it appears after the elevation of the posterior vaginal flap.

removed. A plastic closure was made completely obliterating the vaginal canal by lateral approximation with interrupted sutures of chromic catgut. Convalescence was uneventful and the patient was dismissed with the wound healed.

CASE 5. The patient a woman aged 57 had been married for 31 years previous to examination at the Mayo Clinic. She had had 3 children and 1 miscarriage. Following the birth of the youngest child in 1904 a protrusion from the vagina appeared which was noticeable when the patient strained or stood but which disappeared when she lay down. In 1906 the left ovary and the appendix were removed and internal shortening of the round ligaments and perineorrhaphy were performed. Three years after this operation there had been recurrence of the protrusion so marked that it interfered with walking. In 1913 the Kocher operation for prolapse was performed but 3 months later the protrusion suddenly reappeared and since then has gradually grown larger. There had been backache at times.

On examination in 1927 the uterus was found to be in good position but there was extensive bulging of the posterior vaginal wall more marked when the patient stood. The perineum was in good condition. At operation a flap was dissected free from the posterior vaginal wall and from a thin walled sac extending down in the median line along the anterior wall of the rectum. This sac was identified as peritoneal. It was apparent that the protrusion was caused by a posterior vaginal hernia. There was very little rectocele. The sac was dissected free as far up as possible and a high perineorrhaphy performed below it. The abdomen was opened and the



often accompanied by a gurgling sound or sensation produced by the gas and liquid in the intestines and the mass may be rendered tympanic to percussion by the gas in the included bowel. While any or all of these characteristics may be lacking there is one constant and typical sign of posterior vaginal hernia which is disclosed on rectal examination. When the hernia is in the vagina the finger introduced into the rectum will readily demonstrate that the bulging of the rectum into the vagina no matter how marked constitutes only a small portion of the mass. Anterior vaginal hernia may be distinguished from cystocele by the introduction of a sound into the bladder.

While displacement of the pelvic organs is not necessarily part of the picture in vaginal hernia it is rather common and varying degrees of rectocele, cystocele, prolapse or uterine inversion may be associated with it.

Complications in cases of vaginal hernia are rare. Strangulation is uncommon because the neck of the sac is usually very large in proportion to its size and there is little chance for constriction to occur even in the event of pregnancy. Barker's case developed strangulation which recurred a number of times associated with symptoms of intestinal obstruction. In Case 2 in the present series there were symptoms probably due to partial strangulation which did not recur after the repair of the hernia.

Conditions which occasionally simulate vaginal hernia are cysts and tumors of the vagina. They are extremely rare however and usually may be readily differentiated by careful examination. Miles has pointed out that cysts of Gartner's duct are especially confusing because they may be reduced on pressure, the fluid returning along the duct to a cyst of the parovarium in the broad ligament.

#### ANATOMICAL CONSIDERATION

The posterior type of vaginal hernia is the more common occurring about sixteen times as frequently as the anterior type. In the posterior type the sac emerges from the abdomen through the cul de sac of Douglas and dissects downward between the anterior wall of the rectum and the posterior wall of

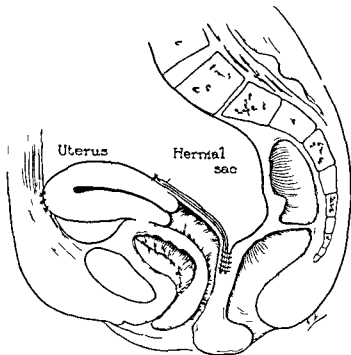


Fig. 5. Completion of the combined type of operation for the repair of the posterior vaginal hernia.

the vagina (Fig. 1). As the vaginal wall is pushed forward it is everted and drops down to form a soft pendulous mass which if sufficiently large protrudes from the vulva.

The pelvic floor according to Thompson is a thick compact mass traversed by clefts or faults the walls of which are normally in contact but which open to allow material to pass through them. Symington states that in the mesial plane the pelvic floor is as a rule about 2.5 centimeters thick. Laterally it varies but is always thicker than in the middle near the lateral wall of the pelvis it is from 5 to 7.5 centimeters thick. Muscles and their fascial coverings compose this floor. The most important of these muscles are the levator ani and coccygeus representing in the human subject two of the tail muscles of lower animals. The part of the levator muscles arising from the posterior surface of the os pubis passes backward laterally to the urethra, vagina and rectum to its insertion in the sacrum and coccyx. Fibers passing across between the urethra and vagina and the vagina and rectum constitute the pubourethralis and pubovaginalis respectively. The levator ani is according to Derby one of the most variable muscles in the body. A congenital weakness or absence of these inter

communicating fibers provides the predisposing condition in the development of vaginal hernia in the event of severe strain. Such a strain comes during pregnancy when the tissues of the pelvis become lax and congested and the trauma of delivery is superimposed. From a consideration of the relative strength of the pelvic floor in its median and lateral portions it will be readily seen that these hernias are likely to occur in the median line and but rarely if ever on either side unless they pass through or entirely lateral to the levator muscles as in the pudendal and perineal type of pelvic hernia.

Anterior vaginal hernias emerge from the abdomen anterior to the uterus and follow downward in the plane of cleavage between the anterior vaginal wall and the bladder.

The coverings of these hernias consist only of the vaginal mucosa and the peritoneum. The contents are in most cases portions of the small intestine but in a few instances large intestine has been found in them. Occasionally when there has been a pelvic infection adhesions form within the sac and about the neck in such a manner that the intestine cannot possibly pass into the hernia and the contents consist of fluid only.

#### ETIOLOGY

Available data are insufficient for drawing definite conclusions in regard to the etiology of vaginal hernia. It is plausible that congenital weakness of the muscles forming the pelvic floor may be an essential predisposing factor especially when vaginal hernia is found in nulliparous women. In the majority of cases however the hernia is acquired and follows pregnancy or some unusual strain or occasionally occurs with a cyst or a large abdominal tumor. In these cases however it is impossible to say that there had not been congenital weakness or faulty development of the muscles of the pelvic floor which might have been the essential predisposing factor. If congenital weakness is not presupposed to be essential it is difficult to explain why there are not more cases of vaginal hernia since the other factors namely pregnancy unusual strain and abdominal tumor or ascites occur so commonly.

#### TREATMENT

Vaginal hernia should be treated surgically. Untreated the hernia tends to enlarge and the use of palliative measures such as supports of various type has proved unsatisfactory. No uniform procedure has been adopted in treatment because vaginal hernia occurs so seldom and because co-existing malpositions of the pelvic organs vary so greatly in different cases. However certain well recognized principles governing the treatment of hernia in general must be adhered to in dealing with vaginal hernia. There are three things that must be accomplished: isolation of the sac, disposal of the sac and repair of the defect at the point of egress of the hernia from the abdomen. The means by which these ends can be accomplished depend somewhat on the condition and position of the pelvic organs.

*Isolation of the sac.* The sac may be most successfully isolated through a vaginal incision. Sometimes a vaginal flap has been dissected free before the hernia is discovered and it remains only to complete the isolation of the sac through this incision. If vaginal hernia has been diagnosed clinically the usual incision for the repair of a rectocele or cystocele depending on whether the hernia is anterior or posterior should be made and the sac isolated (Fig. 2).

*Disposal of the sac.* The hernial sac may be disposed of either through the vaginal or the abdominal route. When the operation is performed through a vaginal incision the contents of the hernia are pushed well up into the abdomen the neck of the sac is ligated and the superfluous portion excised. If a combined type of operation is to be used the hernia is reduced the sac pushed up into the abdomen (Fig. 3 in text) and the repair of the perineum completed in the usual manner (Fig. 3). Then when the abdomen is opened the sac is completely inverted and sutured to the posterior wall of the uterus or sometimes the excystisue of the sac is excised and the opening closed by a purse string suture.

*Repair of the defect at the point of egress of the hernia.* If the neck of the sac is easily accessible repair of the defect at the point of egress of the hernia may occasionally be accomplished through the vaginal incision.

When the sac is disposed of in this manner the levatores ani are drawn together and the operation completed as a high perineorrhaphy. However repair of the defect in the pelvic floor is most satisfactorily carried out through an abdominal incision. A series of purse string sutures is utilized to obliterate the cul de sac of Douglas (Fig. 4) when the hernia is posterior and the vesico uterine space when the hernia is anterior to the uterus. In some cases the colon may be utilized to cover over the weak point in the pelvic floor. The operation may then be completed by the correction of any uterine displacement that may be present. When the patient has passed the child bearing age the uterus may be fixed into the anterior abdominal wall (Fig. 5).

*Special cases* Vaginal hernia in association with certain types of pelvic displacement require special types of repair. In case of posterior vaginal hernia associated with uterine prolapse of advanced degree the the patient being near or past the menopause an operation may be performed entirely by the vaginal route. A vaginal flap is dissected free as preliminary to perineorrhaphy the hernial sac is isolated and disposed of as described. A Mayo vaginal hysterectomy is performed the broad ligaments are sutured together well posteriorly and the operation is completed as a perineorrhaphy or the vagina may be obliterated with approximating sutures of chromic catgut. Two cases in this series were treated in this manner.

The abdomen may be explored preliminary to the vaginal operation when abdominal complications make it desirable. The neck of the sac is closed by a series of purse string sutures and the cul de sac of Douglas is obliterated at the same time. Isolation of the sac and removal of the superfluous tissue as well as any plastic operation on the vagina may be accomplished as a second stage either at the time or later.

When the first stage of the repair is performed through a vaginal incision and the second stage is to be performed through an abdominal one the second stage should be carried out at the same time or before the patient is permitted to be up otherwise these hernias usually recur.

# SUMMARY

Vaginal hernias are rare. A surprisingly small number have been reported in the literature and only 5 have been observed at the Mayo Clinic.

The symptoms are not characteristic and it is only rarely that a diagnosis is made previous to operation. Frequently the true nature of the condition is overlooked even at operation and it may be only after the failure of one or repeated operations that the correct diagnosis is made. Careful examinations will eliminate these errors.

The etiology is not definitely known but it seems plausible that congenital weakness of the muscles which form the pelvic floor may be the predisposing factor in the production of many if not all of the cases.

The treatment is surgical and while it has not been standardized because of the variations in the complicating pelvic conditions the principle of an adequate procedure are well defined and correspond to those governing the treatment of hernias elsewhere.

# BIBLIOGRAPHY

1. BANISTER S. W. The most frequent form of a anal hernia its etiology and treatment. *Med. Rec.* 1901 11 (44) 447.
2. BAKER L. (1891) Vaginal hernia or vaginal enterocoele. *Am. J. Obst.* 18 (1) 1-19.
3. BIRCHALL J. Vaginal hernia perforation of ileum under sudden violence. *Brit. M. J.* 1909 11 18 183.
4. DUFFY D. I. Pelvic muscles and fasciae. *J. Anat. & Physiol.* 1907 1008 11 107-111.
5. KELLY H. A. Operative Gynecology. New York: D. Appleton & Company 1908.
6. LOTHROP H. A. An operation for the cure of vaginal hernia. *Boston M. & S. J.* 1913 11 5/8 580.
7. MILLER J. M. Pelvic hernia: report of a case of posterior vaginal hernia. *Surg., Gynec. & Obst.* 1926 41 482-489.
8. SWEETSER H. F. Vaginal hernia. *Ann. Surg.* 1911 11 609-611.
9. SYMINGTON JOHNSON. A contribution to the normal anatomy of the female pelvic floor. *Ld. Ab. M. J.* 1889 4 11 788-801.
10. TAYLOR JOHN. Case of vaginal hernia. *Lancet* 1831 11 205-207.
11. THOMAS H. T. Vulvar and anal interocoele. *New York M. J.* 1885 11 705-711.
12. THOMPSON LUTHER. Quoted by Cameron John. The fascia of the perineum and pelvis of the female with special reference to the mechanical supports of the pelvic viscera. *J. Anat. & Physiol.* 1908 11 438-455.
13. WARD C. C. Technique of repair of enterocoele (posterior vaginal hernia) and rectocoele. *J. Am. M. Ass.* 19 11 709-713.



PYURIA IN CHRONIC UNCOMPLICATED PROSTATITIS<sup>1</sup>

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U l st M y Cl

THE histories of 500 cases of chronic prostatitis uncomplicated by disease of the upper part of the urinary tract or by urethritis chosen at random from the files of the Mayo Clinic were studied in order to determine the incidence of pyuria. The microscopic examination of the secretion in such cases the number of pus cells in each high power field the presence of degenerated leucocytes and their clumping all enter into the diagnosis.

The grading of prostatitis on the number of pus cells in each field (centrifugized) is as follows: normal 1 to 5 cells prostatitis graded 1 5 to 15 cells prostatitis graded 2 15 to 50 cells prostatitis graded 3 50 to 150 cells and prostatitis graded 4 150 cells or more.

The grading of pyuria on the number of pus cells in each high power field is as follows:

pus graded 1 1 to 20 cells pus graded 2 20 to 50 cells pus graded 3 three fourths of high power field filled with pus cells pus graded 4 whole field packed with pus cells. In male patients urine was considered normal if there was no pus. However the limits of 1 to 10 pus cells in each high power field is usually considered negligible.

The cases for study were divided into four arbitrary groups: (1) those in which clear urine (no pus cells) was present (2) those in which there was pus graded 1 1 to 10 cells in each field (a negligible quantity) (3) those in which pus was graded 1 with 10 to 20 cells in each field (mild pyuria) and (4) those in which pus was graded 2 or more (marked pyuria). Only cases of chronic prostatitis graded from 1 to 4 were studied. The incidence of venereal disease and the relation of chronic prostatitis with and without such

TABLE I—INCIDENCE OF PYURIA

P t	Case	G h r e		C l		P t g r d d l l		P s d d l l		P g r d d m	
		C	P t	C	P	C	P	C	P	C	P t
	6	85	53	5	3	98	6 3	7	4 4	5	3
3	8		55 5	6	34	0	55 6		5 5	9	4 9
4	58	83	52 5	55	34 8	78	49 4		6 9	4	8 8
	500	69	53 8	67	33 4	7	55 4	8	5 6	8	5 6

TABLE II—CASES IN WHICH THERE WAS A HISTORY OF GONORRHOEA

I	C	C l i n		P t g r d d l l		P s d d l l		P g r d d m	
		C s e	P t	C	P	C	P	Cases	P t
	85	3	7 7	52	6	6	7	4	4 7
3		9	8 7	58	57 4	7	6 9	7	6 9
4	83	3	7 5	44	53	5	6	1	3
	69	75	7 8	54	57 2	8	6 7	22	8 2

TABLE III—CASES IN WHICH THERE WAS NO HISTORY OF GONORRHOEA

Prostatitis	Cases	Cl		Pygdit in cells		Pygdd in cell		Pygdd in m e	
Grade		Case	Per cent	Cases	Per cent	Cases	Per cent	C	Per cent
2	75	27	36.0	46	61.3	1	1.3	1	1.3
3	81	33	40	43	53.1	3	3.7	2	2.5
4	5	32	4	34	45.3	6	8.0	3	4.0
	231	92	39.8	123	53.2	10	4.3	6	2.6

TABLE IV—RELATION OF VENEREAL DISEASE TO CONDITION OF URINE

Prostatitis	Cl			Pygded in cell			Pygded in cell			Pygded in m		
Grade	Total	Cases	Per cent	Total	Cases	Per cent	Total	Cases	Per cent	Total	Cases	Per cent
2	50	3	4.0	95	52	53.1	7	6	86	5	4	80
3	6	29	46.7	101	58	57.4	10	7	70	9	7	78
4	55	23	41.8	78	44	53.4	11	5	46	14	11	79

With history of disease

disease to pyuria was also noted. The results of the study are shown in Tables I to IV.

## CONCLUSIONS

1. A history of gonorrhoea was elicited in a little more than half of the cases of prostatitis. The fact that the incidence in the three grades of prostatitis (grades 2, 3 and 4) was about the same would indicate that gonorrhoea bears no relation to the severity of prostatitis.

2. In about one third of the cases the urine was clear and in about 89 per cent it was either normal or almost normal. In 11 per cent there was either mild or marked pyuria.

the more severe the prostatitis the more severe the pyuria.

3. In about 13 per cent of the cases in which gonorrhoea was associated there was either mild or marked pyuria.

4. In the cases of mild pyuria the more severe the prostatitis the less frequent the incidence of gonorrhoea (86 per cent in cases graded 2 and 46 per cent in cases graded 4). The number of cases however is too few in this group to warrant definite conclusions.

5. In the cases of marked pyuria gonorrhoea was present in approximately 80 per cent regardless of the severity of the prostatitis.

## INFECTIVE OSTEO-MYELITIS

By ROBERT KENYON, M.D., F.R.C.S., L.R.C.P. (LOND.)

Lect. P. I. S. Y. U. Y. I. L. P. I.

**I**NFECTIVE osteomyelitis may be defined as a septicæmia which metastasizes in bone. The term schoolboy's disease is metaphorically descriptive of the usual age and sex of the victim. Commonly an obscure history of ill health, colds, boils, tonsillitis, pneumonia or general rheumatic pains will precede the mild pain which localizes the disease in the end of a long bone and since few schoolboys especially among the poorer classes willingly forego their games for a simple cold certain school authorities have found it advisable and provident to insure against the disastrous consequence and sequelæ of this disease a history of trauma is however frequently absent and osteomyelitis in association with simple fracture is a rarity.

Our professional objective in dealing with acute osteomyelitis is to avoid by means of early diagnosis and prompt surgical treatment prolonged suffering and ultimate physical deformity. Generally even in neglected cases life can be saved but it must be borne in mind that in fulminating cases septicæmia will cause death however careful the operator may be to establish free drainage further with pyæmic cases the danger of pericarditis must not be overlooked.

The primary object of the present paper is to define the early diagnostic signs of osteomyelitis. By the aid of these the development of a focus can be successfully checked by immediate surgical interference and thereby much suffering can be averted.

THE PRIMARY OSSIFEROUS FOCUS OF  
OSTEO-MYELITIS

Acute osteomyelitis starts in the shaft of a long bone in an area sometimes termed the metaphysis immediately beneath the epiphyseal cartilage. It occurs but rarely in the epiphysis proper so that the term epiphysitis is a misnomer for the acute disease and in my opinion the term should likewise be used only with great reserve in tuberculosis. The primary focus of osteomyelitis is

almost without exception within the cancellous bone from which position it spreads with variable rapidity and extent to the bone marrow and to the periosteum finally the infection may involve by extension the intramullular planes, subcutaneous tissue and contiguous joints. Since the disease always begins in the center of a bone the use of the term periostitis in this condition should be discontinued it conveys nothing but an entirely erroneous idea of the disease and suggests inadequate treatment.

The earliest characteristic symptom of acute osteomyelitis is pain and tenderness on pressure with one finger over the end of a long bone—briefly describable as one finger rheumatism of bone. This pain is severe in character it renders sleep impossible and its onset is associated with high temperature frequently preceded by a rigor. These few physical signs are certainly diagnostic of the onset of osteomyelitis and if operative procedure follows promptly the ravage of chronic bone disease will be averted in all moderate infection. At the early stage of the infection negative radiological findings are the rule and there is no doubt that X-ray examination of case of acute osteomyelitis within the first 48 hours is often a waste of valuable time and consequently a danger to the sufferer's limb and life.

It must be emphasized that swelling is a late symptom it appears only after 3 or 4 days when the central abscess has tracked through the vascular channels to the periosteum and has formed the subperiosteal pocket. This fact is of importance for differential diagnosis since it will be recalled that the onsets of pain, tenderness and swelling are synchronous in acute rheumatism.

So frequently are the symptoms of this disease misinterpreted during its early stage and false hopes ruined by a negative radiological report that I feel it is of importance to describe accurately the most important position of one finger pain and tenderness

with respect to each of the long bones in order that clinicians may subject the positions to digital pressure in all dubious cases of rheumatism. Probably none of the following observations is essentially original, many of them are confirmations of opinions by various teachers and writers on this subject but so far as I am aware they have not hitherto been recorded systematically. Ample proof that these points of maximal tenderness are of reasonable constancy have been obtained also from the examination of museum specimens and of roentgenograms of chronic cases.

#### MAXIMAL POINTS OF TENDERNES IN EARLY CASES OF ACUTE OSTIOMYELITIS UPPER EXTREMITY (FIGS 1 AND 2)

1 The antero internal aspect of the neck of the humerus

The posterior surface of the lower end of the humerus above the epiphyseal line

3 The posterior surface of the upper end of the ulna

4 The anterior surface of the lower end of the radius above the epiphyseal line

#### LOWER EXTREMITY (FIGS 3 AND 6)

1 The antero internal aspect of the neck of the femur

2 The posterior aspect of the lower end of the femur above the epiphyseal line

3 The antero internal aspect of the upper end of the tibia below the epiphyseal line

4 The posterior aspect of the lower end of the tibia above the epiphyseal line

The last is the most common situation for osteomyelitis in the whole body and in view of the liability of the ankle to trauma during school life memorization of this site and recollection of the etiology and symptoms will obviate many mistakes and disasters.

#### DIAGNOSTIC VALUE OF RADIOLOGICAL EXAMINATION IN EARLY OSTIOMYELITIS

It has already been indicated that in the majority of cases of acute osteomyelitis during the first week radiological examination is a waste of valuable time and may prejudice the patient's life. There is however no doubt that if at the end of 48 hours the case has developed a small local swelling associated

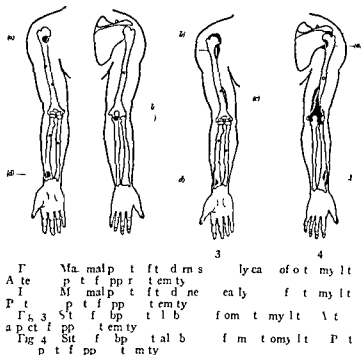
with pain and tenderness over the end of the bone the radiologist—by examining the minute details of prints of the limb taken from different positions—will be able to demonstrate by the slight roughening of the osseous surface the exact position in which the central abscess make its exit such information is clearly of decided value to the operator. If on the other hand marked radiological change in the bone are evident within the first 48 hours after the discovery of the symptoms the case is more probably one of tuberculous osteomyelitis.

Radiological examination affords more conclusive evidence when the case has been neglected or overlooked because sufficient time will then have elapsed for decalcification of the bone to be perceptible and of course if the case is of the chronic type the radiologist's report is invaluable. The history of the case will serve to differentiate instances of decalcification of bone due to hemorrhagic effusions—as in a crushed foot without fracture or infection—or due to passive oedema of a limb from an injury e.g. a gunshot wound.

These general statements are illustrated by the following cases.

**CASE 1** Robert J. 12 years of age collided with a telegraph boy wheeling a bicycle and limped home 7 days later she was seen at a hospital and her case was diagnosed as rheumatism. More accurate cross examination of the mother would have revealed two important facts (1) that the onsets of the pain and swelling were not synchronous and (2) that the swelling when first noticed was over the end of the bone namely on the posterior surface of the tibia behind the internal malleolus and was not at the time a general swelling of the whole ankle joint. On the fourteenth day after the accident the operation took place from the usual situation on the posterior surface of the lower end of the tibia. I evacuated half an ounce of pus from a small subperiosteal abscess and from the center of the bone. To the casual observer the radiogram (Fig 10) was negative even at the end of 14 days but the slight hirtus in the outline of the compact bone (Fig 10a) corresponds exactly in position to the opening through which the central abscess burst beneath the periosteum. This girl in spite of the delayed treatment made an excellent recovery and a year later Dr R. L. Roberts reported that without the history he would not have known from the roentgenogram that the tibia had ever been diseased.

**CASE 2** Dorothy J. aged 13 years had no history of trauma but had suffered for 4 days from



acute pain and tenderness in the lower end of the femur. Her temperature on admission was 103 degrees F. One finger tenderness was present just above the epiphyseal line in the popliteal space. Figure 1 shows the roentgenogram which is negative. Operation disclosed a small posterior but fluid dram of pus within the bone. Complete healing resulted in 6 weeks.

It is unnecessary to quote or illustrate further cases in order to prove and emphasize the necessity for operative measures advocated solely upon the clinical evidence even when the radiological picture discloses nothing abnormal.

#### POSITION AND EXTENSION OF THE SUBPERIOSTEAL ABSCESES

Let us now consider an average case in which some swelling is present. This swelling may be due merely to oedema of the periosteum but much more commonly actual pus is found to be present at the time of the operation. It must be emphasized again that osteomyelitis commences in the bone and therefore the term periostitis conveys a false pathological impression of the disease. The central abscess in the bone probably finds its way to the surface of the bone through the vascular foramina and upon the number of

these depends the situation of tenderness and subsequent swelling. The sites of the swellings which appear about 48 hours after the onset of acute infective osteomyelitis and their method of extension in the upper extremity are illustrated by Figure 3 and 4.

The subperiosteal abscess at the upper end of the humerus spreads equally in an anterior and posterior direction (Figs. 3a and 4a) around the inner side of the humerus and therefore lifts the important vessels inward away from the bone. Early operation upon such a case will show in many instances that the inflammation has not extended into the joint. But unfortunately the capsule of the joint extends downward to be inserted into the periosteum of the humerus and there is joint involvement at this situation does occur early and commonly (Figs. 3b and 4b). General oedema of the arm results from an acute infection at the upper end of the humerus is often maximal over the lower portion of the arm if this fact is recollected surgical exploration at the wrong end of the bone will be avoided.

At the lower end of the humerus the subperiosteal abscess usually spreads upward and laterally (Fig. 4c) more to the inner than

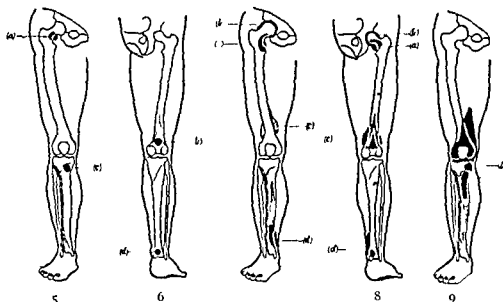


Fig 5 Maximal points of tenderness in early cases of osteomyelitis Anterior aspect of lower extremity  
 Fig 6 Maximal points of tenderness in early cases of osteomyelitis Posterior aspect of lower extremity  
 Fig 7 Sites of subperiosteal abscesses from osteomyelitis Anterior aspect of lower extremity  
 Fig 8 Sites of subperiosteal abscesses from osteomyelitis Posterior aspect of lower extremity  
 Fig 9 Sites of subperiosteal abscesses from focus at the upper end of the tibia

to the outer side and gradually extends anteriorly (Fig 3c). Involvement of the elbow joint by direct extension is common because unfortunately the bone in this region is very thin and because a tongue of diaphysis extends downwards to take part in the formation of the trochlear surface which separates the center of ossification of the internal condyle from the rest of the epiphysis.

The subperiosteal abscess from the upper end of the ulna points backward and must be distinguished from olecranon bursitis, a mild degree of which is also a natural concomitant of osteomyelitis in this position. Joint involvement is rare except in neglected cases.

At the lower end of the radius the subperiosteal abscess (Figs 3d and 4d) extends upwards and outwards beneath the extensor tendons of the thumb and may point on either side of these. Tenosynovitis of these muscles is usually present but this must not divert the attention from the recognition of the causal lesion in the bone.

The situations and modes of extension of the subperiosteal abscesses in the lower limb are illustrated by Figures 7, 8 and 9.

From the neck of the femur a small abscess (Figs 7a and 8a) collects round the neck and at an early period although not invariably it will burst into the hip joint (Figs 7b and 8b). This common and disastrous sequel is surely one which may more often be prevented.

When the central abscess at the lower end of the femur emerges it lifts the loose periosteum between the supracondylar ridges and then extends upward and laterally chiefly on the inner side (Fig 8c) and thus gains the anterior surface of the femur (Fig 7c). Involvement of the knee joint is uncommon because of the relations of the capsule posteriorly and the presence of a subsynovial pad of fat which protects the synovial membrane anteriorly in advanced cases but in fulminating case extension into the joint may occur together with separation of the epiphysis.

From the upper end of the tibia a central infection will spread downward along the subcutaneous anterior surface of the bone (Fig 9a) but because of the close proximity of the capsule of the knee joint to the septic focus joint involvement is a very common although avoidable complication (Fig 9b).

From the lower end of the tibia the abscess spreads inward and upward on to the anterior subcutaneous surface (Fig 8d and 7d). Marked oedema around the malleoli is a prominent feature this in early cases is an effect of gravity and exploration will not reveal any pus at this stage—indeed incisions below the malleoli are indicative of erroneous location they are necessary only to open subcutaneous abscesses in neglected cases. The ankle joint usually develops a serous synovitis but suppurative arthritis there is extremely uncommon. Acute osteomyelitis of the fibula is easily recognized and localized because the bone is subcutaneous.

The acute subperiosteal abscess bears no relation in size to the central abscess indeed Nature may have forestalled the surgeon so far as to leave the patient with a healing central lesion although an extensive subperiosteal abscess is present. In such case no pus under tension will be found on drilling the bone in fact if the patient temperature is low and the aperture connecting the subperiosteal abscess with the central cavity is large drilling may be unnecessary just as a tooth need not always be removed when an abscess is pointing in the neck or on the face. Before leaving the subject of the subperiosteal abscess it may not be out of place to point out that bare bone is not necessarily dead bone and that extensive sequestra involving for example one third of the bone are rare these can be produced only through failure of the periosteum to burst subcutaneously so that a tension is created high enough to induce thrombosis of the nutrient arteries or through injudicious and rough investigation of the abscess cavity at the time of the operation leading to rupture of these vessels. Obviously the nutrient vessels to bone are of great importance and all operators should consequently be familiar with their situations.

#### POSITION AND EXTENSION OF SUBCUTANEOUS AND INTRAMUSCULAR ABSCESES

The subcutaneous and intramuscular abscesses and their subsequent sinuses result in late cases from the bursting of the sub

periosteal abscess. They may point at either border of a covering muscle or may be directed away from the primary lesion by the ease of spread along vessels or by the influence of gravity. The positions at which they are commonly found will now be indicated.

*Upper extremity.* The subcutaneous abscess from osteomyelitis at the upper end of the humerus points on either side but more often at the anterior side of the deltoid muscle near its insertion this in contrast to the case of the clavicle which leaves sinuses near the origin of this muscle. The abscess from the lower end of the humerus points usually just above the internal condyle less commonly it may appear above the external condyle that derived from the upper end of the ulna reaches the surface either directly over the olecranon or under the influence of gravity lower down on the posterior surface of the forearm and the abscess from the lower end of the radius may point on either side of the extensor tendon of the thumb.

*Lower extremity.* An abscess derived from the upper end of the femur may point in three different positions: (1) on either side of the adductor longus tendon with extension from gravitation and in pus abscess down the inner side of the thigh; (2) on either side of the sartorius; and (3) at the lower border of the gluteus maximus toward which it has been directed by the internal circumflex artery and by gravity when the patient has been confined to bed. From the lower end of the femur the abscess points usually on the inner side of the thigh and much higher than may be expected if the patient be in bed with the knee flexed which posture induces the pus to burrow among the posterior muscles. Occasionally in ambulatory case the pus may descend through the popliteal space deep to the calf muscles and reach even to the tendo achilli. An abscess arising from the upper end of the tibia is visible directly over the anterior surface of the bone but if the knee joint is involved the exit is variously situated around the anterior aspect of the joint more commonly toward the inner side of the thigh. The abscess from the lower end of the tibia either points directly over the subperiosteal abscess on the anterior



Fig. 10. Early osteomyelitis of the lower end of the tibia in Case 1. Note the break in the compact bony outline at *a* through which tension was relieved by Nature. The extent of the subperiosteal abscess is indicated by the dotted outline. At *b* there was cedema of the leg but no pus. The extended posture of the ankle is to be observed. A preliminary aspiration of the joint revealed a yellow tinged synovial fluid. Ankle movements commenced the following day, were painless and no stiffness resulted.

surface of the tibia or influenced by gravity often travels deep to the internal annular ligament and points on the inner aspect of the foot.

#### SITES OF MAXIMAL DISEASE AS ILLUSTRATED BY MUSEUM SPECIMENS

The pathological changes resulting from chronic infective osteomyelitis of acute origin are apparent in the photographs taken from specimens kindly lent by Prof. E. E. Glynn. In Figure 12 there is a large cloaca posteriorly in the metaphysis of the lower end of the femur but the joint cartilage is comparatively healthy. Figure 13 exhibits in the posterior aspect of the bone an involucrum or bridge of new bone formed from the raised periosteum; in this case the epiphysis and joint are healthy. In Figure 14 there is a large sequestrum on the posterior surface of the



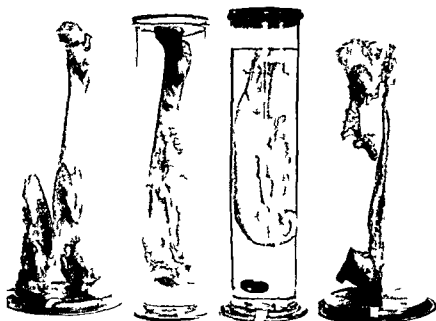
Fig. 11. Early osteomyelitis of the lower end of the femur in Case 1. Radiological evidence was negative.

femur the rest of the bone is healthy but it is so definitely thickened that in pre-radiological days the leg was amputated on the assumption that the condition was sarcomatous (Brodie's abscess); the joint is healthy.

These specimens may serve to confirm the statements that the septic focus originates in the metaphysis; that at the lower end of the femur it is the posterior surface which is almost invariably affected and that involvement of the joint need not necessarily follow even in neglected cases.

Three photographs are reproduced of chronic osteomyelitis of the upper end of the tibia; they are all probably of tuberculous origin. In Figures 16 and 17 the lesions are diaphyseal and the joints are healthy; the carious sequestrum in the latter figure is apparent. Figure 18 depicts a cold abscess in bone with a pyogenic membrane situated in the diaphysis and extending posteriorly and subperiosteally into the knee joint. These figures demonstrate that the initial focus of osteomyelitis at the upper end of the tibia is on the anterior surface of the bone.





I g O teomy lit f th l we m t phy f th fem h la p t  
 r 1  
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 F 4 O t omy lit s f th l r d of the f m ho th k f l  
 d post ly a l g qu trum  
 l 5 R lt f p t l d phy ect my f th t b f t myel t

and is diaphyseal in origin. The significance of these specimens in the elucidation of the starting points of tuberculous osteomyelitis and arthritis will be discussed later.

#### TREATMENT OF ACUTE INFECTIVE OSTEOMYELITIS

Most surgeons will limit their technique to drilling the bone in the earliest stage and will rouge only when a well formed central abscess is present. Within the first 3 weeks subperiosteal resection should never be performed. Cases are exhibited from time to time of reconstructive operations to replace a portion or the whole of the shaft; their success depends on performance at a late period of the infection when radiological evidence can be obtained that new bone is being laid down by the periosteum. Partial diaphysectomy is not an operation to be lightly undertaken in cases received at the

onset of the disease. The final result in a patient who survived this operation is illustrated in Figure 15; the deranged axis of the knee and ankle joints should be noted and the ligamentous tissue which once joined the ends of the bone.

In approaching the lesion in the bone it is advantageous to modify the incision so that the surface of the bone may be drilled or gouged in the most desirable position; surely it is bad surgery to drill the anterior surface of the lower end of the tibia or femur or the posterior surface of the radius and every endeavor should be made to establish drill holes on those surfaces where, as has already been described, the central abscess most commonly reaches the surface. Again when opening the subperiosteal abscess due regard must be paid to the nutrient artery, since if this be damaged one third or one half of the bone may be lost. Damage to the nutrient

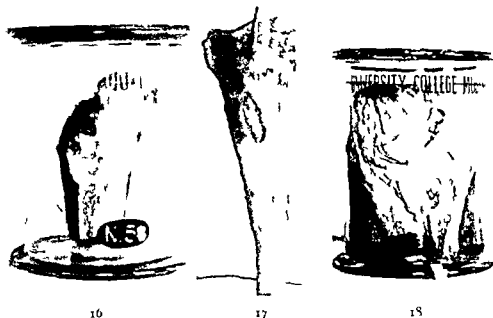


FIG. 16 Chronic osteomyelitis (tuberculous) in diaphyseal portion of the upper end of the tibia

FIG. 17 Chronic osteomyelitis (tuberculous?) in diaphyseal portion of the upper end of the tibia showing carious sequestrum

FIG. 18 Cold abscess (tuberculous) with pyogenic membrane in the diaphyseal portion of the tibia the infection traveled posteriorly and subperitoneally into the knee joint

vessel is usually the result of late surgery but occasionally it may be due to bad surgery just as osteomyelitis of the patella can be produced by a careless operator through the nicking of the patella when a suppurating pre patellar bursa is being opened or excised

Free drainage is the keynote of success and frequent probing of the sinus must be avoided All secondary operations for the removal of sequestra should be well spaced in regard to time and we should remember that normally it takes about 6 weeks for a sequestrum to separate X ray examinations are of extreme value but less so than the intermittent bursts of pus as an indication of the presence of dead bone which even in large bulk is occasionally undetectable in a roentgenogram

#### JOINT INVOLVEMENT FOLLOWING OSTEOMYELITIS

If the early diagnostic signs are regarded and if the operation is undertaken without delay this complication should occur much less frequently than it does It arises of course most commonly in those joints in which the capsule extends on to the metaphysis The knee from the upper end of the tibia the hip from the femur the shoulder

from the humerus and the elbow from the humerus are all very commonly—or almost constantly—involved and this need not be the case provided early treatment is accomplished The involvement of the joint is far too often the result of a rupture into the joint of the subperiosteal collection of pus which could easily have been evacuated from below and extra articularly if the condition had been recognized in time

#### TUBERCULOUS OSTEOMYELITIS AND ARTHRITIS

The method of joint involvement just stated affords an explanation of why those in charge of surgical tuberculosis not infrequently obtain entirely successful results in cases diagnosed as tuberculous arthritis Thus the perfect joint movements which follow treatment e.g. of a hip exhibiting muscular spasm and cold abscess formation force one to the conclusion that the primary tuberculous focus on spreading to the periosteum has failed to extend into the joint and that the case has remained throughout one of osteitis and not of arthritis

A series of roentgenograms which Dr T H Martin medical officer in charge of the Leasowe Cottage Hospital for Surgical Tuber

cule has kindly lent me contradicts the assumption and illustration of Clot<sup>1</sup> that tuberculosis commence beneath the articular cartilage. The initial lesion lie about the epiphyseal cartilage & frequently on the diaphyseal side & in acute infective osteomyelitis. This opinion has also been formed from my small clinical experience of adult cases and it is supported by pathological evidence (Hunt 1914, 15).

A word of warning is again necessary upon the influence of negative radiological reports especially in adult although in contrast to acute infective osteomyelitis definite radiological evidence is present in the more acute forms of tuberculosis within 48 hours of the onset of pain etc etc frequently occur where a cold abscess of large size precede by months definite radiological evidence in the pine hip etc So frequently are early cases of tuberculous diagnosed as hysterical and discredit thereby brought upon our profession that we would urge practitioners to reserve their diagnosis of obscure joint complaint until 4 roentgenograms taken at 3 monthly intervals have failed to reveal a focus - unless of course a cold abscess formation remove the doubt - and to treat such cases provisionally as tuberculous paying particular attention to the toxemia by which they are usually accompanied

It should be noted in this connection that the occurrence of unexplained swelling over the end of a bone often indicates deep seated tuberculosis (Osteitis) not always in the direction indicated for acute infective osteomyelitis, thus for example from a focus at the lower end of the tibia the abscess may point forward.

Because of the segregation of surgical tuberculosis, general surgeons have fewer opportunities for studying such cases but

they cannot fail to appreciate the good results obtained by conservative rather than operative measures.

If howe'er radiologically more diaphyseal lesions are being demonstrated than the textbooks would suggest—there is surely an indication that from time to time those accustomed to bone surgery will be tempted to explore this early lesion on the rare occasions when it is encountered rather than let nature take its course. When the latter method is followed joint involvement may ensue—a course which reminds one of the history of paratyphitis when the appendicular focus was unrecognized.

## SUMMARY

1. The foci of acute osteomyelitis are in the diaphysis of long bones; their positions and line of extension to the periosteum are almost invariable and are indicated for each long bone.

Maximal tenderness on deep pressure over the osseous focus is present and of diagnostic importance in early stage prior to the development of the subperiosteal abscess which usually form on the diaphyses near the emphyseal line.

Fluorograph in early case may be valuable and misleading only those which are taken tangentially to the position at which the subperiosteal abscess usually forms are likely to show evidence of early disease.

4. Surgical procedure by the route indicated should be directed to the points of maximal tenderness without delay in order to obviate extension to the joints.

Tuberculous infection appear to originate in one or two foci and to extend similarly for extremely early and operative measures at the hand of experts appear logical.

M t h a k l t P f h E K l l y f l n  
 t l k l l t l t m l p l l f W l t J  
 D l l f l b l t t h t h l l t t t c

# THE SURGICAL IMPORTANCE OF X-RAY EXAMINATION OF THE TRACHEA AND THE BRONCHI

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AND  
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C. I. H. A. R. I. b. n. I. C. I. U. S. C.

It is well known that the trachea is easy to examine by means of roentgen rays and the reason for this is that it is a hollow cylinder filled with air which is embedded in organs of greater density. The result is that the wind pipe absorbs much less of the rays than the vicinity, thus making its differentiation easier. But we must not only be able to create an X-ray picture of the trachea; we must also recognize change in its form and position. As long as we had examined the trachea only with a sagittal direction of the rays, our knowledge of such changes remained circumscribed for a plate or a fluoroscopic examination under sagittal irradiation can reveal only lateral displacements or corresponding compression of the wind pipe but will never disclose a dorsoventral displacement or a corresponding narrowing of the tracheal lumen. A picture of the latter changes can be secured only through lateral irradiation of the trachea (7).

The patient lies on one side at an angle of 90 degrees to the table (Figs 1-5). The shoulders are bent maximally backward, the arms are pulled backward and the hands are clasped. In this position with the humeral epiphyses directly over each other the patient is fixated with the girdle of the Bucky Potter diaphragm; the knees drawn up (this makes the position more stable).

The patient's head is fixated at a natural height by means of bandings and one should see that it is neither extremely stretched nor bent forward. The plate should be about 18 by 4 centimeters or 4 by 6 centimeters (large format). The long side of the plate should be parallel to the long axis of the patient's body. The central ray should fall upon the mid point of the clavicle farthest from the plate; the protection of the ray finally falling on the center of the plate. Littenfeld's technique for lateral photography of sternum is similar.

Figure 4 demonstrates a normal trachea in lateral projection. In contrast with plate taken with patient in anteroposterior position which would show the thoracic portion of the wind pipe very unclearly at the best, we see the whole trachea with the cervical and thoracic sections as far down as the bifurcation. The lateral picture is *per se* better than the dorsoventral picture because it does away with the disturbing vertebral shadows, thus making the picture clearer and also because it is possible to reveal the whole length of the wind pipe. The picture in lateral projection makes it easy to recognize any changes or displacements of the trachea in a dorso-anterior direction or any flattening of the tube in the same direction.

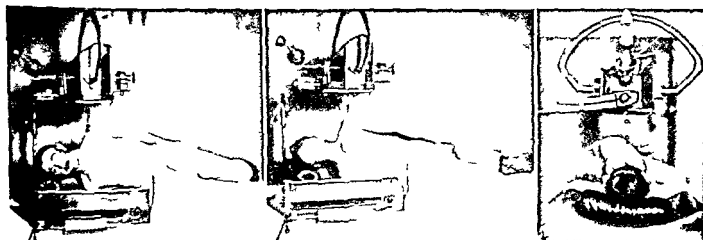


Fig 1

Fig 2

Fig 3

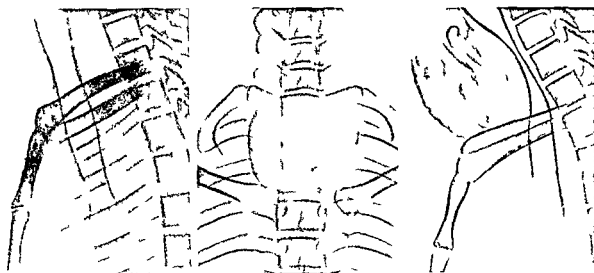
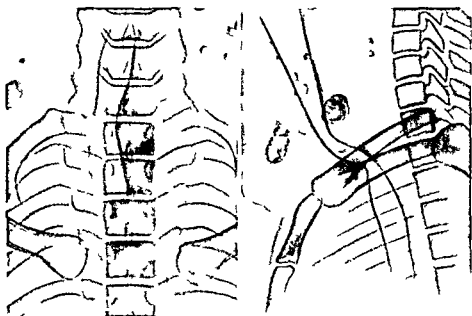


Fig 41 ft N mlt ch l t lp jct f tby l f d t m Th t p t p ject  
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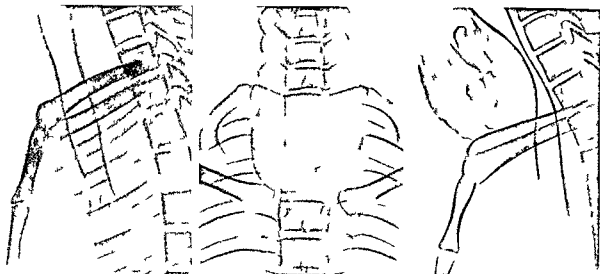
11. 6 Retrotracheal calcified struma. The anteroposterior projection is on the left the lateral projection is on the right



11. Retrosternal struma. The anteroposterior projection is on the left the lateral projection is on the right

compression of the trachea and will hardly be come conscious of any disturbance. It is true that such patients are always in danger since even a moderate swelling of the mucous membrane as a result of a tracheal catarrh may lead to most severe dyspnoea and suffocation. It is therefore necessary that an X-ray examination of the trachea of goiter patients be done even though the patient does not complain of dyspnoea. It is not at all necessary that the extent of the changes in form or position be commensurate with the size of the goiter and these changes are

often small in large tumors and can be found quite great in small ones. Accurate knowledge of the condition of the trachea is a prerequisite for operation of the thyroid. The surgeon must be well oriented on the changes in form or position of the trachea before he operates; he must know especially from which side the pressure of the thyroid tumor acts upon the wind pipe and to what degree this pressure has stenosed the trachea. Often a large thyroid lobe causes little or no symptoms of compression while a small node may provoke the severest symptoms of stenosis.



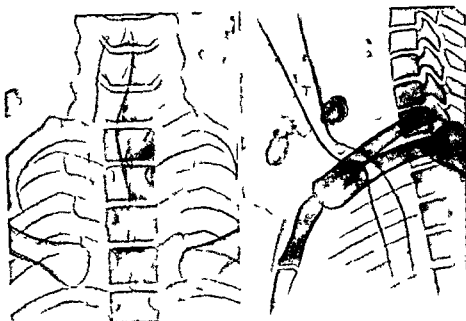
F 4 l f t N m l t h l t l p j e c t  
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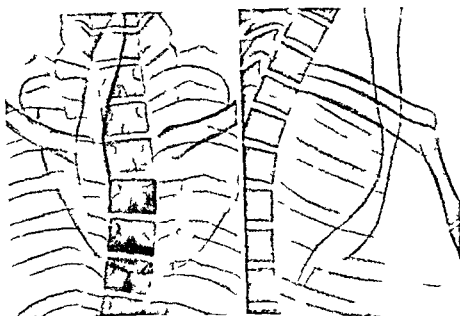
If we add the sagittal examination of the trachea to the method of lateral projection we achieve even greater orientation as to changes in form and position. In addition to the X-ray picture which is of great importance fluoroscopic examination is also of special value in the examination of the trachea because it permits us not only to examine the wind pipe in the two chief meridians of space but it also permits us in turn to turn the patient about to examine the trachea in an infinite number of meridians although not as clearly as with a picture. This combined method not infrequently affords us complementary material as to the character of the tracheal compression. Granted that there is good light a wind pipe with a regularly wide lumen will appear equally wide all along its course at every position of the patient and its contour will be very definite since the tracheal diameter (and thus also the thickness of the column of air in the trachea which is cut by the central ray) must be the same in every projected direction because of the practically cylindrical shape of the tube. Fluoroscopic examination of a trachea the lumen of which varies at different points as due for example to goiter compression is quite different. If we suppose that the pressure of the goiter occurs on the left and right sides and reduces the size of the lumen equally from all sides to about half the size then the thickness of the column of air which is cut by the central ray will be different in different positions of the patient. The narrowed portions of the wind pipe will become sharper in the fluoroscopic picture in that ray

meridian in which the central ray passes the greatest diameter of the trachea that is in the case mentioned in a sagittal direction and in compressions in an oblique direction when the patient is placed in a suitably oblique position. It is inherent in the nature of the X-ray examination that it should permit of an easier and more accurate determination of displacements and compressions of the trachea than laryngological methods whereas other questions pertaining for example to the condition of the mucous membranes innervating disturbances etc are solved only by the latter method.

Changes in the form and position of the trachea are most frequent in cases of goiter. It is in these cases that an objective determination of the condition of the trachea is of the utmost importance since as is well known dyspnea in a goiter patient is not necessarily caused by tracheal compression but may be due to disease of other organs more frequently that of the heart or the lungs (we must emphasize the close connections between goiter and the heart). The operative removal of the goiter in a patient in whom the dyspnea has falsely been considered as due to a compression of the wind pipe by the struma would do the patient no good but would expose him to no little danger because of the reduced resistance of the heart or the lungs. We must also bear in mind the frequent and surprising incongruence between the extent of the tracheal stenosis and the degree of dyspnea. Thus patients whose goiters grow slowly will be able to accustom themselves to the gradual and regular



11-6 Retrotracheal calcified struma. The anteroposterior projection is on the left the lateral projection is on the right

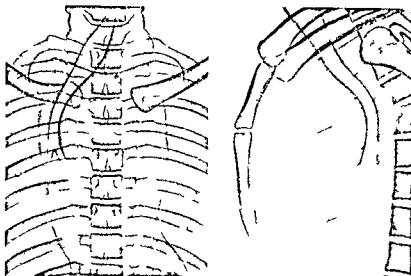


11 Retrosternal struma. The anteroposterior projection is on the left the lateral projection is on the right

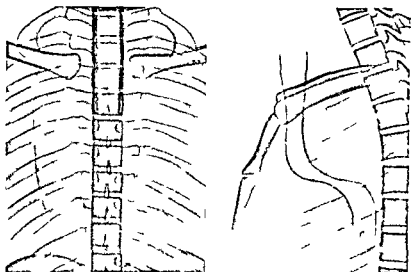
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F 8 T t t f t t l l f m f t h t h  
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I 6 O M d t l t l l t l p j t t t l l t l  
 t f t j h f f m t h t h t h f h t h  
 th t p t p j t t t h l f t

The possibilities of X-ray examination of the trachea are not exhaustively the determination of changes in form and position with this method rather than with any other one is also letterable to determine whether or not there is a retrosternal trachea present. Precisely such knowledge regarding intrathoracic goiter—whether the latter be as usual simply a continuation of the goiter of the neck or whether the tumor is an isolated one in the breast cavity—seems to us to be of

great importance from the well-being of an intrathoracic action of a goiter as a result of inflammation or hemorrhage may cause larger pressure on the trachea especially as the rigid walls of the latter preclude the equal distribution of such pressure in other directions. If ignorant of the presence of such a condition one may remove the tumor but the cause of the stenosis the retrosternal struma is left. In the determination of the presence of a retrosternal

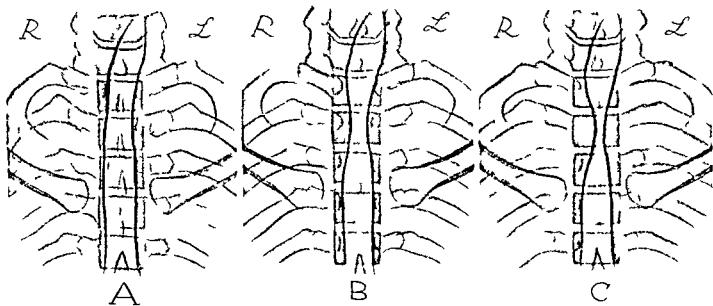


Fig 10 Tracheomalacia of the right tracheal wall A Val alva's test (increase in intratracheal pressure) There is a considerable increase in the width of the tracheal stenosis especially due to a protrusion of the right wall B Anteroposterior projection of a trachea compressed

to the form of aaber sheath by pressure on the right and left from a goiter (normal intratracheal pressure) C Mueller's test (decrease in intratracheal pressure) Considerable narrowing of the trachea especially due to the further depression of the right wall

strum fluoroscopy plays a great role simultaneously affording us important information on the condition of the heart and lungs In addition to the size and position of the tumor X-ray examination permits us to gain information on the degree of its displacement when the patient coughs and swallows Since the goiter is attached

to the wind pipe it must be lifted on coughing or swallowing unless it is more solidly attached to the neighboring structures The X-ray determination of whether or not the goiter is sufficiently lifted under these circumstances is one of the important criteria for the kind of treatment (operative or conservative) If the displacement

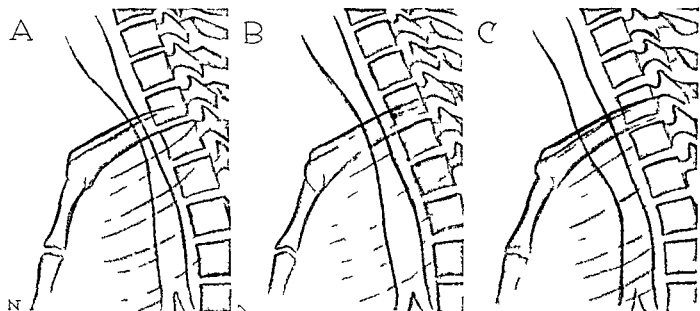


Fig 11 Malacia in the region of the anterior tracheal wall A Mueller's test (reduction of intratracheal pressure) Considerable narrowing of the trachea as a result of the further depression of the anterior tracheal wall B Lateral projection of a trachea compressed from

the front by a goiter (normal intratracheal pressure) C Val alva's test (increase in intratracheal pressure) Considerable widening of the trachea due to distention of the anterior tracheal wall

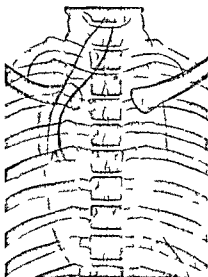


Fig 8 T p t n f t l e t h  
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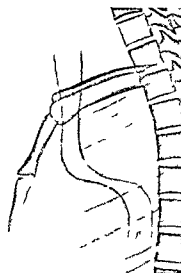
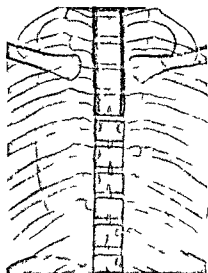


Fig 8 M t t l tum Tl l t l f j ti ( n th ght) l a  
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th t p t p j t t t l l f t

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great importance for a moderate swelling of intrathoracic section of a goiter as a result of inflammation or hemorrhage may cause dangerous pressure on the trachea, especially as the rigid wall of the latter preclude the equal distribution of such pressure in other directions. If ignorant of the presence of such a condition we may remove the tumor but the cause of the stenosis the retrosternal struma is left. In the determination of the presence of a retrosternal

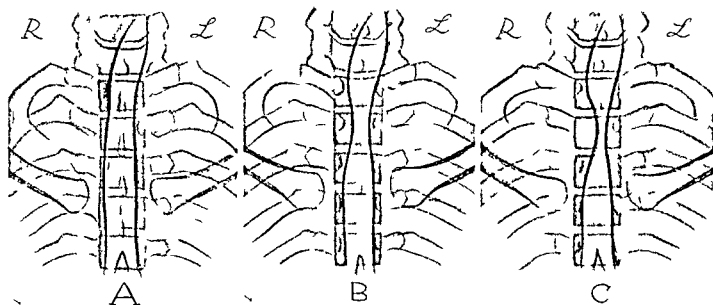


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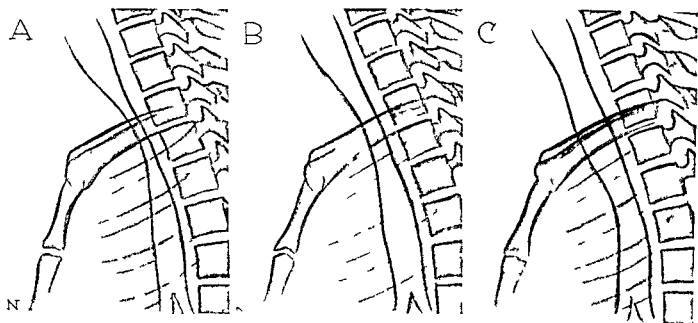


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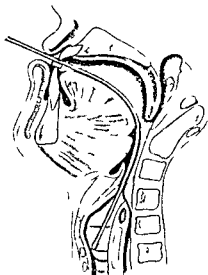


Fig 3 Shows the lateral view of the trachea and the surrounding structures. The tube is shown in the trachea.

is but moderate then we must consider that adhesions are present which would make operation difficult. An attempt to dislodge an intrathoracic goiter which has been fastened to the neighboring organs may easily lead to the rupture of thin veins and thus also to air embolus or asphyxia. The length of operation can enhance the incidence of a mediastinal emphysema, provoke injuries to the pleural apex, damage to the nervus recurrens, etc.

We present some pictures which illustrate the value of X-ray examination of the trachea from both the sagittal and lateral aspects. Figure 5 shows in the anteroposterior picture on the left a dense shadow in front of the wind pipe. This is seen to be a calcified struma in the lateral view

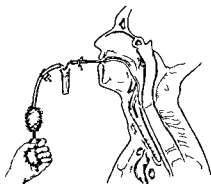


Fig 5 Shows the lateral view of the trachea and the surrounding structures. The tube is shown in the trachea.

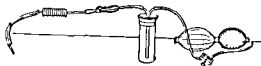


Fig 6 Shows the trachea and the surrounding structures. The tube is shown in the trachea.

shown on the right. But there is still another reason why the trachea was hardly visible in the anteroposterior view. The trachea has been so flattened in the sagittal direction that the X-rays pass through a very narrow layer of air in the tube, thus creating a hardly visible picture. Figure 6 illustrates the changes which affect the trachea as a result of a calcified retrotracheal struma. As is shown in the lateral view on the right, the trachea has been pushed forward and compressed from behind. In the anteroposterior picture on the left, the trachea is hardly recognizable because of the frontal flattening. A marked compression of the wind pipe as a result of the action of a retrosternal goiter is illustrated in Figure 7.

Displacement and compression of the trachea are found not only in cases of goiter or glandular tumors of the neck, but as the examination of the trachea in pictures of two perpendicular projections will show, such changes are also found in intramediastinal diseases, especially mediastinal tumors and aneurisms of mediastinal vessels, but also not infrequently in diverse diseases of the lungs (contractive processes, tumors, etc.) and the pleura (effusions, accumulation of air and tumors). The condition of the trachea can among other symptoms often be a differentially diagnostic factor between aortic aneurism and mediastinal tumor (6). Whereas an aneurism, especially one of the aortic arch, will displace the trachea in a lateral direction, such a change of position, with the presence of a mediastinal tumor, takes place in a dorsoventral direction (with the exception of intrathoracic goiter). A marked compression of the trachea, as is so often found in X-ray examination of mediastinal tumors, is seldom found in cases of aneurism. The type of tracheal displacement further affords us a means of diagnosing the source of the aneurism (ascending or descending aorta, the arch). Corresponding to the topographic relationships, aneurisms of the ascending aorta will displace the trachea frequently toward the left and backward, whereas aneurisms of the arch, corresponding to their proximity to the left wall of the trachea, will displace the latter toward the right. Aneurisms of the descending branch finally will push the

trachea toward the front or the right if they are still within the region of the trachea altogether. The most intimate relationships with the trachea are to be found in cases of aneurism of the arch.

If in the case of an unilaterally contracting pulmonary tuberculosis the trachea is not only pulled to one side but also advanced toward the anterior or posterior wall of the thorax the clinical methods of examining by percussion and auscultation may lead to the mistaken diagnosis of cavities. The marked transposition suffered by the trachea in cases of aneurism of the arch are illustrated by Figure 8. Figure 9 shows a twofold bend in the trachea in the lateral view on the right. This picture is from a case of mediastinal tumor and the anteroposterior picture on the left gives no idea of the severe changes which the trachea has suffered. These are to be seen only in the lateral view on the right.

X-ray examination of the changes in form and position affecting the trachea the diagnosis of an intrathoracic goiter the determination of the condition of the heart lungs and esophagus do not entirely complete the possibilities of this method. We are also able by means of X-ray examination to form an opinion on the *resistance of the tracheal cartilage* an important consideration in determining further procedure. It is precisely this knowledge which should not be underestimated in considering the amount of danger to the patient which results from the pressure of the goiter on the wind pipe. The solidity of the cartilage may be reduced by the pressure of an old goiter the cartilaginous support may disappear in part and the ominous picture of *tracheomalacia* may appear and threaten the life of the patient. With X-ray examination this condition can be



Fig. 14. The patient holds the laryngeal catheter between his teeth ready for filling the bronchial tree while behind the X-ray apparatus.

recognized and is an absolute indication for operation even though the cartilaginous structure of the trachea is itself not visible. Such a weakening of the cartilaginous support of the wind pipe may be deduced from the way in which the lumen of the trachea is widened or narrowed by increase or decrease in intrathoracic pressure (8). It will not be difficult to conclude that malacic changes of the cartilage are present in the region of a tracheal stenosis if the width of the tracheal lumen increases markedly upon increase of intrathoracic pressure or if the former is definitely reduced upon reduction of the latter. The increase in pressure is provoked by Valsalva's test (expiration with the external air passages closed) a decrease by Mueller's test (inspiration with the external air passages closed). These remarkable oscillations in the width of the tracheal lumen during these tests are easily explained by the reduction in resistance of the tracheal wall at the points of malacic transformation. With increase in pressure this transformation leads to an abnormal protrusion of the wall as soon as the intratracheal pressure is reduced.



Fig. 16. Position of the patient for filling the right lower lobe in bronchography.



Fig. 17. Position of the patient for filling the right upper lobe in bronchography.



Fig. 9. B. n. h. g. p. l. v. N. m. l. l. h. l. t. f. t. h. l. t. l. t.

there is necessarily a marked depression at the same point. On the other hand the changes in shape of the trachea in cases with unaffected cartilaginous rings are relatively light; they are at least equal on both sides, concentric, whereas the malaciac changes are usually asymmetrically marked, eccentric, because the affection usually seizes but one side of the tracheal wall. We are thus able to make a functional examination of the cartilaginous support of the tracheal wall by test its reaction to increase and decrease of intra-tracheal pressure and to gain important information on its resistance. However it will be too much to have the examining physician explain both the Valsalva and the Mueller tests to every goiter patient during X-ray examination of the trachea. This will be especially impossible in the case of the mass material of a clinic. It is quite sufficient for practical purposes to substitute simple coughing for the Valsalva test and sniffing (Hit enterger) for the reduction of intra-tracheal pressure. Before the patient carries out the measures he must be slowly turned into the position in which the fluoroscopic picture in which the trachea is most visible is the position in which the central ray passes through the greatest diameter of the tracheal lumen.

There is naturally a gradual transition in many cases from marked malacia to normally constituted cartilaginous rings and the cases with varying degrees of reduced resistance are marked by correspondingly large or small excursions upon changes of pressure. In such cases it is of especial value to make a picture in order to compare definite stages of the form of the trachea under

normal and varied pressure conditions (Valsalva and Mueller tests).

An excellent case of tracheomalacia is illustrated in Figure 10. The tracheal stenosis is seen in the middle with the breathing normal (i.e. under normal air pressure (there is a saber sheath compression)). The picture on the left shows the condition of the trachea when the pressure is increased (Valsalva test) and the one on the right when the air pressure is reduced (Mueller's test). There is a very great difference in the width of the lumen between the pictures A and C. The malacia primarily affects the right wall of the trachea. A second case of tracheomalacia which was especially recognizable in the lateral view is illustrated in Figure 11. The center picture B shows the lateral view of the trachea with normal breathing (i.e. normal pressure conditions). The trachea is pushed in from the front. The picture on the left shows the condition of the windpipe when pressure is reduced (Mueller's test) and C shows the trachea under increased air pressure (Valsalva). The changes in the size of the lumen are remarkably great. The X-ray examination suggests a diagnosis of tracheomalacia of the anterior wall of the windpipe (cervical section). In this case as well as in the foregoing one and in many others the operation corroborated the roentgenological findings.

The systematic testing of the resistance of the tracheal cartilages to changes in pressure during X-ray examination is likely to become very helpful in our choice of the type of treatment for



Fig. 10. B. n. h. g. p. l. v. N. m. l. l. h. l. t. f. t. h. l. t. l. t. m. p. t.

gout patients. It need not be especially emphasized that a diagnosis of marked malacia is an absolute indication for operation. In the presence of even a slight reduction in the resistance of the cartilaginous support of the trachea operation would seem advisable unless severe diseases of the heart or lungs were present.

X-ray examination of the effect of pressure changes on the tracheal wall will doubtless be of especial value for therapeutic indications—operative or conservative treatment—in those complicated cases in which a large portion of the tumor reaches down into the mediastinum and compresses the thoracic section of the trachea and in which the thyroid tumor is seen to be hardly movable, i.e. attached to its vicinity upon coughing and swallowing behind the fluoroscopic plate. In such cases it is very difficult to decide upon treatment particularly if marked cardiac lesions are present. A diagnosis of a weakening in the tracheal cartilages in the thoracic section will make it more advisable to operate despite the dangers of operation than to treat the patient expectantly, granted of course that the internal findings have also been taken into consideration.

#### BRONCHI

In this paper we wish to consider only the method of bronchography which has been developed in recent years: the method of introducing a substance—an iodized oil, iodipin (Merck) or lipiodol—into the bronchial tree which throws a shadow and thus makes the X-ray examination of even the finest branches of the bronchi possible. The method of contrast fillings of the bronchial tree was first suggested by an American, Jackson

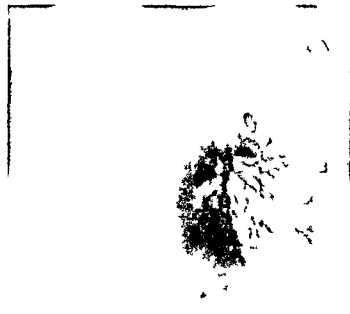


Fig. 1. Bronchography. Iodized bronchiectases.

and by Lynch. It was only a few years later, however, that the method experienced a remarkable advance through the work of Sieard, Forstner and Leroux. These authors all mentioned different methods of introducing the contrasting iodized oil, but all these methods have the common characteristic that the X-ray examination of the lungs is carried out only *after* the iodized oil has been introduced into the bronchi. The introduction of the contrast mass is thus done without the guidance of the roentgenologist. This not infrequently leads to a lack of filling in precisely those bronchi which are of diagnostic interest. To obviate this difficulty Haslinger, who carried out such examinations with Lenk, constructed a bronchial sound which, after the larynx and the trachea have been anesthetized, can be introduced into any desired bronchus and the contrast medium injected. This method will hardly become generally used since it demands a rather high degree of specialization and also puts a greater burden on the patient than is desirable, especially if the patient is tuberculous. Beck and Sgalitzer have developed a method at the Vienna Ear and Surgical Clinics (1 and 2) which is simple, which does not demand too much assistance on the part of the patient, and which also possesses the advantage of introducing the iodized oil directly into the bronchial tree under the control of the X-ray. The entrance of the iodized oil into the bronchial branches is observed on the fluoroscopic plate, so that this becomes analogous to the fluoroscopic examination of the stomach.

The method consists in first anesthetizing the larynx and then introducing a soft catheter which

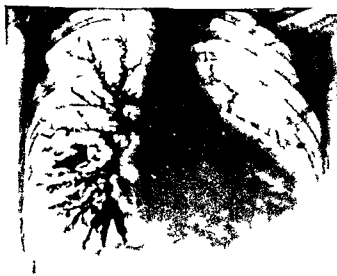


Fig. 2. Bronchography. Cylindrical bronchiectases.



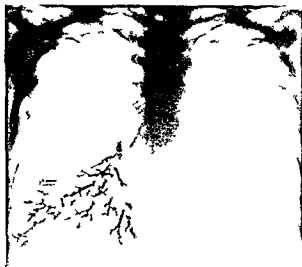


Fig. 10. B. Howell. Physical examination of the trachea.

there is necessarily a marked depression at the same point. On the other hand the changes in shape of the trachea in cases with unaffected cartilaginous rings are relatively light they are at least equal on both sides concentric whereas the malacic changes are usually abnormally marked eccentric because the affection usually involves but one side of the tracheal wall. We are thus able to make a functional examination of the cartilaginous support of the tracheal wall by test its reaction to increased intraluminal pressure and to gain important information on its resistance. However it will be too much to have the examining physician explain both the Valsalva and the Mueller tests to every goiter patient during X-ray examination of the trachea. This would be especially impossible in the case of the material of a clinic. It is quite sufficient for practical purposes to substitute simple coughing for the Valsalva test and sniffing (Hitzelberger) for the reduction of intratracheal pressure. Before the patient carries out these maneuvers he must be slowly turned into the position in which the fluoroscopic plate in which the trachea must lie is the position in which the central ray passes through the greatest diameter of the trachea.

There is naturally a great transition in many cases from marked malacia to normally constituted cartilaginous rings and the cases with varying degrees of reduced resistance are marked by correspondingly large or small excursions upon changes of pressure. In such cases it is of especial value to make a picture in order to compare definite stages of the form of the trachea under

normal and varied pressure conditions (Valsalva and Mueller tests).

An excellent case of tracheomalacia is illustrated in Figure 10. The tracheal stenosis is seen in the middle with the breathing normal (ie. under normal air pressure (there is a saber sheath compression). The picture on the left shows the condition of the trachea when the pressure is increased (Valsalva test) and the one on the right when the air pressure is reduced (Mueller's test). There is a very great difference in the width of the lumen between the pictures A and C. The malacia primarily affects the right wall of the trachea. A second case of tracheomalacia which was especially recognizable in the lateral view is illustrated in Figure 11. The center picture B shows the lateral view of the trachea with normal breathing (ie. normal pressure conditions). The trachea is pushed in from the front. The picture on the left shows the condition of the wind pipe when pressure is reduced (Mueller's test) and C shows the trachea under increased air pressure (Valsalva). The change in the size of the lumen is remarkably great. The X-ray examination suggests a diagnosis of tracheomalacia of the anterior wall of the wind pipe (cervical section). In this case as well as in the foregoing one and in many others the operation corroborated the roentgenological findings.

The systematic testing of the resistance of the tracheal cartilages to changes in pressure during X-ray examination is likely to become very helpful in our choice of the type of treatment for

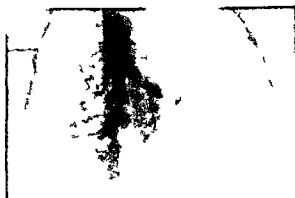


Fig. 11. B. Howell. Physical examination of the trachea.

gout patients. It need not be especially emphasized that a diagnosis of marked malacia is an absolute indication for operation. In the presence of even a slight reduction in the resistance of the cartilaginous support of the trachea operation would seem advisable unless contraindications of the heart or lungs were present.

X ray examination of the effect of pressure changes on the tracheal wall will doubtless be of especial value for therapeutic indications—operative or conservative treatment—in the complicated cases in which a large portion of the tumor reaches down into the mediastinum and compresses the thoracic section of the trachea and in which the thyroid tumor is seen to be hardly movable i.e. attached to its vicinity upon coughing and swallowing behind the fluoroscopic plate. In such cases it is very difficult to decide upon treatment particularly if marked cardiac lesions are present. A diagnosis of a weakening in the tracheal cartilages in the thoracic section will make it more advisable to operate despite the dangers of operation than to treat the patient expectantly. Granted of course that the internal findings have also been taken into consideration.

#### BRONCHI

In this paper we wish to consider only the method of bronchography which has been developed in recent years: the method of introducing a substance in iodized oil (iodipin (Merck) or lipiodol) into the bronchial tree which throws a shadow and thus makes the X ray examination of even the finest branches of the bronchi possible. The method of contrast fillings of the bronchial tree was first suggested by an American, Jackson



Fig. 1. Bronchography. Inverted bronchiectases.

and by Lusch. It was only a few years later however that the method experienced a remarkable advance through the work of Sieck, Forrester and Laroux. These authors all mentioned different methods of introducing the contrasting iodized oil but all these methods have the common characteristic that the X ray examination of the lungs is carried out only after the iodized oil has been introduced into the bronchi. The introduction of the contrast mass is thus done without the guidance of the roentgenologist. This not infrequently leads to a lack of filling in precisely those bronchi which are of diagnostic interest. To obviate this difficulty Hashinger who carried out such examinations with Lusk constructed a bronchial sound which after the larynx and the trachea have been anesthetized can be introduced into any desired bronchus and the contrast media injected. This method will hardly become generally used since it demands a rather high degree of specialization and also puts a greater burden on the patient than is desirable especially if the patient is tuberculous. Beck and Sgalitzer have developed a method at the Vienna Ear and Surgical Clinics (1 and 2) which is simple which does not demand too much assistance on the part of the patient and which also possesses the advantage of introducing the iodized oil directly into the bronchial tree under the control of the X ray. The entrance of the iodized oil into the bronchial branches is observed on the fluoroscopic plate so that this becomes analogous to the fluoroscopic examination of the stomach.

The method consists in first anesthetizing the larynx and then introducing a soft catheter which



Fig. 2. Bronchography. Cylindrical bronchiectases.



F B h p h y A f m l h t

remains in place during the entire time of the examination. Whereas the fluoroscopy could heretofore be carried out only after the contrasting oil had been introduced, this method makes it possible to observe the patient behind the X-ray plate continually from the time the oil is allowed to flow into the bronchi and to keep the patient freely movable. The roentgenologist is completely independent of the laryngologist during the time the oil flows into the bronchi. Since also the patient is freely movable during the instillation of the liquid, it is possible to turn him into any position desirable for the filling of different parts of the bronchial tree.

It is not possible to observe certain parts of the lungs, for example the bronchial tree of the upper lobe or of the lower lobe, by means of a suitable transposition of the patient during this method of examination.

In all our examination the use of the iodized oil marketed by the firm of Merck under the name of Iodipin. It is a 40 per cent oil which gave us excellent contrast shadows and was well tolerated by the patients. We observed symptoms of iodism in only a few cases and in but a moderate degree, since the splitting off of iodine from the oil proceeds very slowly. The examination of the urine reveals the presence of but small quantities of iodine. For the prophylaxis of the patients who perhaps swallow small quantities of the iodized oil, it is well to make a practice of administering a purgative after the introduction of the oil.

Even in cases in which we used large quantities of about 20 to 30 gram of Iodipin (15 cubic centimeters are usually sufficient) we never observed any mentionable dyspnea, and in cases treated



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with smaller quantities of about 15 cubic centimeters there was never any dyspnea at all.

Sometimes there is a slight rise in temperature following the instillation of the iodized oil which lasts for about a day. The method developed by us permits us to work satisfactorily with relatively small doses of the iodized oil, since we constantly control the contrast filling with the eye.

The apparatus used by us (Figs 1, 3, 13, 14 and 15) consists of a semi-soft catheter with a diameter of 2 millimeters. A fine silver wire is attached to this catheter, the latter being placed under the glottis after the larynx has first been anesthetized. The silver wire holds the supple catheter in place in the laryngeal curvature desired and also permits of a constant control and observation of the position of the latter. The portion of the catheter in the mouth is attached to a hard rubber cup held in the teeth, so that the position of the catheter remains constant throughout the entire procedure of filling. The catheter is further connected with a small Junker apparatus by means of a rubber tube, the flow of the iodized oil being controlled by opening or closing a clamp attached to the connecting tube. The other tube of the Junker apparatus is attached to a regular double bulb which permits easy regulation of the pressure of the flow of the Iodipin.

After the larynx has been anesthetized with a 10 per cent solution of cocaine, the catheter controlled by the laryngeal mirror is introduced under the glottis and the patient is told to grasp the rubber cup in his teeth. The small Junker apparatus is filled with Iodipin and the patient is then ready to be fluoroscoped.



Fig. 4 Bronchography in thoracoplasty There is a bronchial fistula here

The patient is thus freely movable and the roentgenologist can place him in any position desirable for the filling of any portion of the bronchial tree. Pressure on the bulb forces the iodipin through the catheter into the trachea and thus into the bronchi. It is thus possible to observe where the oil flows from the very beginning. As soon as that part of the bronchial tree which is diagnostically important has been filled the clamp on the connecting tube is closed the instillation thus stopped and the catheter taken out of the larynx. To prevent coughing with certainty we also always anesthetize the trachea by means of a cocaine adrenalin spray in addition to the pharynx and larynx.

An even more simple technique which was also developed at the I Surgical University Clinic in Vienna and used repeatedly there is the method of *swallowing the wrong way* (Verschlucken) (3). This method is also advantageous in that it permits of simultaneous X ray observation as in the method mentioned above. The method is based on an observation of Nather's who in injecting contrast media in the esophagus of a patient with an esophageal carcinoma simultaneously but unintentionally also injected the bronchial tree with the barium mixture. The patient who was anesthetized had simply swallowed the whole mixture down the trachea (he later coughed the mixture up and had no complaints). This and other observations show that a patient whose larynx and pharynx are an-

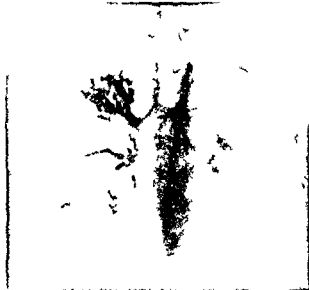


Fig. 5 Bronchiectasis in one of the upper lobes

esthetized often swallows the wrong way as is not unknown to laryngologists. What had happened unintentionally at that time was then later used by us as a method for filling the bronchial tree.

We first have the patient clean his teeth and mouth by brushing and gargling repeatedly. Then the pharynx hypopharynx and laryngeal entrance are thoroughly anesthetized with a 10 to 15 per cent cocaine solution. As soon as anesthesia is complete the patient is allowed to drink the contrast oil behind the fluoroscopic plate in repeated small portions. If the anesthesia has



Fig. 6 Bronchography Bronchiectases in one of the upper lobes



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been really complete the great majority of patients will swallow the oil down the trachea and the flowing in of the oil as well as the direction of its course by any desirable position of the patient can be observed behind the plate.

Now and again the method of swallowing fails especially in patients with an infantile form of the epiglottitis. The method should not be used in the presence of acute or chronic infections of the buccal or pharyngeal cavities (for example tonsillitis sinusitis epipharyngitis and ozæna). The restriction of not of course holding good for the method with the laryngeal catheter for the introduction of the catheter is independent of the form of the epiglottitis and the fluid used drops directly into the trachea and thus avoids any infectious material contained in the nasopharyngeal cavity. We have never observed any damages as a result of this swallowing method. We nevertheless now use the method with the catheter almost exclusively since it is not only practicable in all cases but also possesses the advantage that the iodized oil introduced does not come in contact with the mucous membrane of the mouth.

It is easy to see the advantages of filling the bronchial tree with contrast media under the control of the eye by means of X-ray examination. Most important of all we are able by means of this method to measure the quantity of the oil introduced and to interrupt the further flow of oil as soon as we have satisfactorily answered the diagnostic questions. This enables us to attain diagnostic results with relatively small doses of iodized oil. The possibility of controlling the flow of the oil into the bronchial tree also enables us to direct its course to a great extent. If for



I g s B h h j hy l n h l ma Th  
ff t l b h h b fl t d by th tum Th  
ll ked Tl od ed l ll t d fl er t th  
l h lt f th h lthy d lth gh th p t t  
b t f r ti aff t l f d th t f ct t  
th l

example large quantities of the oil collect in the wind pipe we can immediately interrupt the further introduction of oil until the contrast fluid has again begun to drip slowly into the bronchial tree. This precludes the possibility of many complaints on the part of the patient—dyspnoea and coughing. It is also possible to direct the flow of the oil into certain desired parts of the bronchial tree by means of the suitable transposition of the patient.

The simplest portion of the lung to fill is the lower lobe. Tipping the body of the sitting patient at an angle of 30 or 45 degrees towards the detector side will lead to the proper effect (Fig. 16).

The introduction of iodized oil into the upper lobes of the lung is more difficult. Whereas we formerly did this type of filling with the patient in side position and perhaps with the pelvis raised behind the X-ray wall we later abandoned this method and began to use the X-ray table because the necessary displacements of the Crookes tube box of the irradiating wall the work at the iris diaphragm in short the whole business of controlling the flow of oil into the bronchial tree under X-rays was too greatly hindered by the position of the patient on a simple examining table before the X-ray glass. We now carry out such fillings only on the X-ray table the patient being turned on one side at an angle of about 90

degrees by means of pillows (Fig 17) In addition to this lateral turning it will usually also be necessary to create some elevation of the pelvis by placing some flat pillows under the patient's buttocks One should pay especial attention to the fact that the patient's head must not be the lowest point of the body The head should be raised somewhat by means of a pillow or a roll in order to keep the entering oil from collecting in the wind pipe and thus provoking coughing If with this method the iodized oil enters only the larger bronchi of the upper lobe in question it will be well to increase the elevation of the pelvis as soon as the filling has been completed and simultaneously to tell the patient to breathe deeply a few times One then observes that the contrast fluid enters the finer bronchi also and sometimes even fills the apical portions of the lung

It will not be difficult to fill the right middle lobe if the patient is placed horizontally on the table and turned about 30 degrees on the right side

It is at any rate important to keep the lungs under X ray observation during the entire period of iodized oil treatment since there are no absolutely binding rules for filling certain parts of the lung and since the position of the patient's body must frequently be corrected according to the momentary condition of the bronchial filling Thus it will often become necessary to increase the pelvic elevation in filling the upper lobe when the observer sees that the oil is not flowing entirely or in great part into that lobe or the side position of the patient's body will have to be increased in fillings of the lower lobe whenever the X ray observation reveals that a part of the oil is entering the chief bronchus of the other lung

The most important prerequisite for the introduction of iodized oil into certain definite portions of the bronchial tree is as complete an anesthesia as possible which precludes any coughing during the filling Observations on patients with bronchial fistulae in whom the contrasting agent was introduced without the use of cocaine anesthesia have shown (5) that the small branches of the bronchi and the alveolar tissues tolerate the presence of bismuth without reaction Coughing begins only when the column of bismuth has reached the hilus region i.e. the bronchi of the first and second order A violent coughing reaction is then provoked at the bifurcation and in the trachea On the basis of this observation it becomes apparent that not only the larynx and pharynx but also the trachea should be anesthetized by means of a cocaine

spray The degree of sensitivity varies greatly from patient to patient Whereas some patients are completely anesthetized by slight quantities of cocaine and the introduction of the iodized oil then goes forward without any reaction there are other patients in whom the choking and coughing reflexes are difficult to remove and can sometimes be stopped only after the use of an alcoholic solution of cocaine and a morphine injection It is better to leave the lung unfilled than to do it under insufficient anesthesia since the desired effect will not be achieved under improper circumstances The patient continues to be restless will not remain in the position necessary for the filling in question and also coughs most of the oil back out A small quantity of the oil is pressed by the patient into the small bronchial branches and even into the alveolar tissue whenever the patient is able to keep the coughing back (this is then equal to an unintentional Valsalva test) but this usually concerns a portion of the lungs which is not at all in question We thus lay great weight on as complete an anesthesia of the pharynx, larynx and the tracheal mucous membrane as possible and believe that this is the circumstance which reveals alveolar fillings so seldom nowadays

We have never observed any harm resulting from an alveolar filling on the contrary we achieved an especially favorable therapeutic effect by such a filling in a patient with a very old chronic bronchitis and a very thick secretion We nevertheless try to avoid such a filling as an undesirable co effect The iodipin or lipiodol which reaches the alveoles remains there and can some times be seen hardly diminished in quantity after several months The resorption in the alveoles is unusually slow

In acute catarrhal conditions in which a satisfactory anesthesia is very difficult to attain we wait with the tracheobronchial filling until the acute symptoms have subsided regardless of the basic disease in question

Whatever contrast oil is in the smaller and larger bronchi is usually excreted rapidly In addition to the coughing and the action of the ciliated epithelium the active effect of the peristalsis of the smooth musculature of the tracheobronchial wall is also of importance as Reinberg (1 c) was able to show At any rate the rapidity of the excretion of the oil depends also upon the rigidity of the thorax wall the elasticity of the lungs etc Although the small and large bronchi rid themselves of their contents rapidly there often remain roentgenologically noticeable quantities of the material in the smallest branches as a wall precipitate Such residual material can

often be seen after 24 hours and sometimes even after 2 or 3 days. The small residue which is normally found in bronchi with a macroscopically normal structure even a few days after introduction is always to be found in pathological conditions of the bronchi such as bronchiectasis and decomposing foci in the lungs. Such residue remains for a more or less protracted period of time and can always be seen roentgenologically. The residual oil and also the fine precipitates which we can find only by chemical means are the sources of a possible *therapeutic effect* especially inasmuch as the iodized oil comes into closer contact with the walls of the bronchi after the other contents have been previously coughed up during the process of cocaine anæsthesia. As a matter of fact we have observed a favorable therapeutic effect in a number of cases by the introduction of iodized oil into the bronchial tree in cases with small bronchiectases and bronchitis with thick secretion. In the case of large bronchiectases filled with pus in which the iodized oil cannot come into contact with the wall of the cavity nothing is to be expected. The attempts to introduce medicaments into the bronchial tree are old but the method developed by us for introducing such medicaments under the control of X rays is the first attempt to exclude accidents in such medication and to apply the agent with great certainty to the point of disease. In order however to achieve such ends the medicament must be of such a nature that it becomes visible under X rays or else the agent must be mixed with some substance which throws a shadow. Such basic substances which throw a shadow under X rays are the 40 per cent iodipin (Merck) and lipiodol which are both as mentioned above combinations of iodine with the higher fatty acid. These substances are also important because of their iodine content. (We recall the important role of iodine medication in pulmonary tuberculosis.) As already mentioned this close combination between the iodine and the fatty acids permits of only a very slow splitting off of iodine so that the danger of iodism is to be considered only for patients with an iodine idiosyncrasy. These preparations also cause no unpleasant symptoms from the gastrointestinal tract. They are both oils substances which are especially suitable for use in the bronchial tree and have a consistency which is very similar to that of the bronchial mucus a circumstance which seems to us to be of especial advantage. These oils are well tolerated by the bronchial mucous membranes. On the suggestion of Pal (4) we have repeatedly introduced a mixture of equal parts of iodipin (40

per cent) and agoleum into the bronchial tree in cases of bronchiectasis and chronic bronchitis. Agoleum is a silver preparation which was introduced by Pleschner for the treatment of the bladder. The density of the shadow despite this dilution was nevertheless so good that the 40 per cent iodipin alone hardly gave a better picture although agoleum alone is hardly noticeable in the X ray picture of the lung.

In respect to the quantity of iodized oil to be used for therapeutic purposes we can say that we never use more than 10 to 20 cubic centimeters for the bronchial tree. As soon as the medicament has passed a bronchus of the second order i.e. as soon as it has reached a pulmonary lobe it enters the different branches of the bronchi of this lobe alternately. This is due to the fact that the distribution of the filling in any section of the bronchial tree is subject to a constant change. With every more or less forceful expiration when ever the throat is cleared or as a result of the action of the bronchus peristalsis some of the iodized oil is forced from the smaller to the larger bronchi in order then to flow back into other smaller bronchi at the next inspiration. The viscous character of iodipin explains why small quantities of the oil always stick to the bronchial wall and thus have some therapeutic effect.

We make a practice of filling but one lobe or at least but one side at one sitting. We leave an interval of at least 5 or 8 days between bronchial fillings. As already mentioned there is a slight rise in temperature after the bronchial filling in some patients. In cases we observed a rapid rise to over 38 degrees C but the temperature dropped in both cases to normal within 4 hours. Such rises in temperature seem to occur especially in patients with tuberculous process in whom we no longer carry out the filling. Usually however no disturbance results from the filling and the patients often feel much better because coughing becomes so much easier.

Bronchial filling with iodine oil is not dangerous if quantities no greater than the ones mentioned are used. Aside from one transient cocaine intoxication which is not the fault of the method itself we have never seen any damages despite a great number of cases thus handled. However we do not consider the method to be fool proof. A filling should be carried out only if there is a possibility of a real diagnostic or therapeutic gain. It is natural that we should not only take the condition of the lungs into consideration before making a filling (we believe that an exudative form of pulmonary tuberculosis is a contra indication to the filling) but we should also pay attention to

the general condition of the patient. Thus for example patients with severe cardiac or aortic changes or very nervous patients should not be treated.

Finally we wish to present pictures which illustrate the importance of bronchography (Figs 18 to 8).

Figure 18 shows a normal bronchial tree of the right lower lobe. Figure 19 illustrates the bronchial tree of a retracted lung in the case of an empyematous cavity. This case presented the question as to whether there was a decomposition focus in the shrunken lung. The result of the bronchography answered the question in the negative. Figure 20 illustrates immense cylindrical bronchiectases. Figure 21 grape like bronchiectases. Figure 23 very extensive cyst like ones and Figure 21 smaller bronchiectatic sacks.

Figure 24 illustrates a thoracoplastic because of tuberculosis. Bronchography shows that there is a bronchial fistula present.

That the filling of the bronchial tree of the upper lobe is possible with the right technique is shown by Figures 25 and 6. In both cases bronchiectases are noticeable in the upper lobes.

Figure 27 illustrates an alveolar filling. As we have already mentioned such an alveolar filling is not desirable although we have never yet seen any detrimental results. The resorption of the iodized oil from the alveoles is very slow and hardly noticeable. Such an alveolar filling is enhanced and is made liable to occur if an anesthesia of the alveoles is incomplete.

Figure 28 illustrates a bronchial carcinoma. The left bronchus is distended like an Indian club and then follows an apparently complete block. The bronchus is manifestly substituted by the tumor. The iodized oil collects in the bronchial tree of the healthy lung despite the fact that the patient was turned at an angle of 45 degrees toward the affected side and was finally laid on the diseased side altogether.

The introduction of iodipin into the bronchial tree is undoubtedly a great help in the radiological diagnosis of pulmonary affections. Bronchography is especially valuable in the diagnosis of bronchiectasis because of the difficulties in clinical diagnosis and localization of this disease and in the X ray examination without a contrasting agent. Bronchography can also be of great importance in the diagnosis of doubtful tuberculous cavities, foci of destruction in the course of gangrene, abscesses and their resultant cysts and bronchial carcinoma. We cannot fail to mention that the possibility for studying the way in which the bronchial tree branches under

normal and pathological conditions, the nature of its excretion under coughing in healthy and diseased lungs, open new vistas to research.

#### SUMMARY

In the X ray examination of the trachea of goiter patients the lateral view is also of importance in addition to the frontal one. It is only by means of the double examination in two major spatial directions that we are able to gain definite information on changes in the form and position of the wind pipe. Fluoroscopy is also of great importance since it enables us to see a malacia of the cartilaginous rings—a strict indication for operation because of the danger of death—in addition to affording us information as to the presence of any possible intrathoracic goiter or changes in the heart or lungs. Malacic changes in the cartilages but also slight reduction in the resistance of these cartilages are to be diagnosed by means of the marked dilatation of the trachea upon increase in intratracheal pressure (Valsalva's test) or an abnormal narrowing when the pressure is reduced (Mueller's test). The degree of difference in the size of the lumen depends upon the degree of malacia of the cartilages. To simplify the examination of such conditions of the wind pipe it is sufficient simply to have the patient cough behind the fluoroscopic plate to increase pressure or to sniff in reducing intratracheal pressure. Great difficulties in deciding whether operative or conservative therapy should be followed especially in cases complicated by serious heart lesions will often be removed by means of such a test of the resistance of the cartilaginous support of the trachea.

A method of introducing a contrasting oily fluid into the bronchial tree by means of a catheter for bronchography is reported. The method possesses the advantage over former methods of permitting of constant roentgenologic observation of the treatment from the very beginning. The method also prevents the iodized oil from coming in contact with the buccal mucous membranes. The patient can be brought into any desired position and the direction of the flow of oil in the bronchial tree so controlled as to fill any desired part of the lungs (including the upper lobes) at will. Only one side should be filled at one sitting if possible only one lobe.

The most important factor which is necessary for successful bronchography is complete anesthesia of the pharynx, larynx and the tracheal mucous membrane (the latter by means of a cocaine spray). Although the method is harmless with good technique it should be used only with a definite



indication in mind especially for the diagnosis of bronchiectases. New possibilities for the introduction of medicaments which throw shadows are also discussed.

## BIBLIOGRAPHY

- BCK O AND SGALITZER M Ueb B n h pl  
m ttels Laryn k th t s Z t l bl f Ch i o  
1537  
LECK O AND S ALI ZER M Z B h ph  
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## LARSEN-JOHANSSON'S DISEASE OF THE PATELLA

By GFORGI W HAWLEY M D FACS A ARTHUR S GRISWOLD M D B IDGEF T CONVE TICUT

THE precise diagnosis of lesions about the knee joint has of late reached a degree of considerable exactitude because of the increasing interest in the so called internal derangements of the knee. Thus it was a matter of unusual interest to the authors to come upon an apparently unknown pathological entity.

## CASE REPORTS

J F a boy 12 years of age presented himself on April 6 1927 with the complaint of constant pain and a limp following a mild strain of the left knee sustained during a football game the previous autumn. He had not been seriously disabled but had noticed a certain amount of discomfort after exercise.

Examination of the knee showed nothing more than tenderness confined to the lower margin of the patella. The roentgenogram showed a definite accessory center of ossification in the lower part of the patella singularly this was most clearly shown in the right knee in which no symptoms were then apparent. Furthermore on the left distal end of the tibia a small rounded bony shaped tubercle was found in the distal end of the tibia. Schlatter's disease (18) without symptoms. A distal end of the tibia Schlatter's disease was made and the case treated as such by support with adhesive plaster and restriction of activity. In one month tenderness had disappeared and the knee appeared normal again.

Five months later the patient returned complaining of recurrence of pain at the same time in both knees

after playing football and riding a bicycle. Examination then showed some swelling and tenderness over both patellae at their lower borders especially the left and there appeared to be some actual bony enlargement at this point. Roentgenograms showed the patellae to be pear shaped with well marked knob on the lower poles where fusion of the separate centers of ossification to the main bone as well as an distal end of the tibia as interesting to note that while the separation between the two centers of ossification was distinct in the roentgenograms taken in April there was marked progress in the fusion of the two between April and October (as indicated in Figure 1 and 2). Treatment similar to that given previously resulted in a prompt disappearance of all symptoms.

It may be of interest to mention the fact that this boy was the son of a famous football coach and that his first cousin had had bilateral Schlatter's disease a year previously.

As no case with similar clinical or roentgenological features had ever come to our attention a search of the literature was therefore undertaken in an attempt to determine whether or not any similar lesion had been hitherto described. Nothing was found in either the English or German literature which seemed to have a bearing upon the subject but articles by two Scandinavians were discovered in which each author independently described precisely the same condition.

In 1921 Dr. Sinding-Larsen (14) recorded as a new clinical entity the case histories and

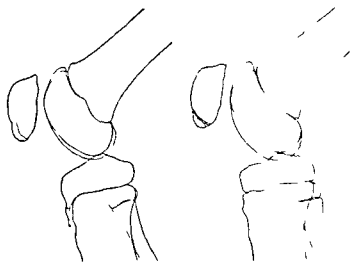


FIG. 1. Case 1. Roentgenograms illustrating the appearance of both knees in April 1927. The left knee (with symptoms) shows an accessory center of ossification at the lower pole of the patella, also the beak-shaped tibial epiphysis with fragmentation (symptomless) present in Osgood-Schlatter's disease. The right knee (symptomless) shows even more clearly the separate center of ossification in the patella. Here the tibial epiphysis is normal in shape.

roentgenograms of two otherwise healthy girls aged 10 and 11 years respectively who after overstraining themselves by dancing and jumping had complained of pain in their knees. When the patients were seen by the author the affection was in each case clinically unilateral, the lower pole of the affected patella was painful on pressure and in one of the cases the soft parts over and below the patella were slightly swollen. In the roentgenograms of the knees taken in profile the anterior and lower outlines of the painful patellae were hazy with abnormal calcium deposits or bone shadows in the periosteum below the patellar apices. The author interprets these findings as indicating epiphysitis caused by overstrain and offers in support of his conclusions the findings of a mild Schlatter's disease of the tibial apophysis (without symptoms) in one of the cases. The roentgenograms of the healthy knee in both cases showed similar abnormalities in a lesser degree. The first case was treated by immobilization in plaster for 6 weeks, the second with rest without fixation. In each case a complete recovery, both clinically and roentgenologically, resulted after 6 months of treatment.

In 1922 Dr. Sven Johansson (8) unaware of Larsen's paper reported the same con-



FIG. 2. Case 1. Roentgenograms of the same knee as shown in Figure 1, 7 months later. The left knee shows fusion of the accessory center of ossification in the patella which is now well advanced. The beak-shaped tibial epiphysis is also partly fused with the diaphysis. The right knee shows the progressing fusion of the separate center of ossification but at a less rapid rate than in the left knee.

dition as in apparently unknown lesions of the patella. Four cases were recorded by him as follows:

CASE 1. A girl aged 11 years complained of the gradual onset of pain in both knees. For 2 or 3 months the pain had been worse after gymnastic exercises. Examination showed tenderness and some swelling over the lower poles of both patellae, especially the right. The roentgenograms showed a separate irregular center of ossification at the lower pole of each patella, more clearly defined on the right. This side also showed the roentgenographic picture of a typical Schlatter's disease of the tibial tuberosity, although clinically symptomless. On the left where the patellar changes were less marked the tibial apophysis was normal in appearance. Treatment by rest and support resulted in a complete recovery in 3 months. Roentgenograms at this time showed the apices of the patellae to be somewhat plumper than normal but there was complete fusion of the separate centers of ossification.

CASES 2 and 3. Two boys aged 13 and 12 years respectively developed knee pain after vague injuries incurred several months previously. In Case 3 the characteristic roentgenographic changes of Schlatter's disease were present upon the affected side although no clinical symptoms were present.

CASE 4. A girl aged 13 years had pain for 3 years but it was confined to one knee.

Each of these patients made a prompt and complete recovery after the knee had been relieved from strain for 1 month or two.

From a consideration of these 6 cases and the 1 which we have reported, several points of interest appear worthy of mention. In the

first place the age distribution is restricted to the period of most active growth that is from 10 to 14 years and the symptoms apparently develop only in children who lead an especially active life. Second in order of the cases with unilateral symptoms roentgenograms of the apparently normal knee in each case showed identically the same changes but to a lesser degree. Third it seems of some significance that in 4 of the cases the typical roentgenographic changes in the tibial epiphysis present in O good Schlatte r s disease should exist without symptoms. Fourth the x ray changes of these lesions involving the upper and lower points of attachment of the patellar ligament are very similar.

According to Adams and Leonard (1) the patella is not infrequently subject to anomalies in development. Ossification commences at the age of 5 or 6 year and the development is usually from one center. However congenital anomalies with two or more centers of ossification are more common than generally supposed and are frequently mistaken for fracture. Such anomalies are usually bilateral and eventually the various centers usually fuse more or less completely to form one bone. The usual site of such an accessory center of ossification is at the outer margin of the patella as first pointed out by Kempson (9) in 192. In some instances instead of fusing with the main bone the ossification persists as a separate center and thus has been frequently mistaken for vertical fracture of the patella as pointed out by various authors from time to time. In 1920 McNally (5) in a study of a large series of patellæ obtained from cadavers found that 3 per cent had a more or less marked defect at the upper outer margin of the patella with or without a true accessory center of ossification at this site. He found that such defects of ossification were bilateral in two thirds and unilateral in one third of the case. Of special interest in the large number of anomalous patellæ which he describe is one with a definite partially fused separate center of ossification at the attachment of the patellar ligament to its lower pole. So far as could be ascertained no earlier mention of a center of ossification at this site had been made in the literature.

Many theories as to the etiology of Schlatter s disease have been advanced by various investigators since it was first described in 1903. One group consider it to be a purely local non traumatic lesion and describe it variously as apophysis tibialis adolescentum (Alsberg in 1908) osteochondritis secondary to prepatellar bursitis (Kienboeck in 1910) epiphysitis tibialis dessicans (Ebbinghaus in 1913) irregular periosteal growth (Peter in 1913) and infectious periostitis (Graf in 1915).

A second group consider Schlatter s disease only as a part of a generalized affection of the bones and joints. This is termed a general disturbance of ossification (Lanz in 1905) late rickets (Jakobstal in 1907) a deformity from disturbances of growth (Bergmann in 1909) and a systemic disease characterized by periosteal separation and general ligamentous weakness (Schulze in 1913).

The purely traumatic theory of etiology was advanced by Altschiel in 1918 but few are willing to subscribe to this theory. In 190 Mueller after a thorough and impartial review of the whole question advanced the reasonable hypothesis that trauma *per se* was not the original cause but only acted on a pre existing weak spot due to local or generalized irregularity in growth. In support of his contention he reported a case of bilateral Schlatter s disease with marked roentgenological findings (though mild clinical symptoms) which showed similar changes in the lesser trochanters more pronounced on the right than the left and also in the lower pole of one patella in which there was irregularity of outline and periosteal elevation entirely without clinical symptoms. From this he concluded that Schlatter s disease was a local manifestation of a systemic process characterized by a tendency to pathological epiphyseal injury brought about by the strain of attached ligaments and tendons without noteworthy traumatism. If he is correct in his assumption it would seem logical to conclude that Larsen Johansson s disease is another such local manifestation which develops at the site of an occasional anomalous epiphysis in the patella. It is interesting to note that Lewin (16) in a recent discussion of apophy-

sitis of the os calcis states that he believes that this constitutes another lesion of a similar nature involving an epiphysis which serves as an attachment for a large tendon

### CONCLUSIONS

In the authors opinion a clear parallelism exists between Larsen's and Schlatter's disease. In each instance there is anomalous bone formation—in the latter the beak shaped tibial epiphysis in the former the accessory center of ossification at the apex of the patella. Therefore it is natural to believe that a potential mechanical weakness exists at the lower end of the ligamentum patellæ in the one case at the upper end in the other. We believe that the two lesions are not usually associated with sudden trauma but are the result of continued strain on the patellar ligament which not infrequently occurs during such vigorous exercises or games as horseback riding, football, jumping, etc. Furthermore the clinical signs and symptoms, roentgen findings, course, prognosis and treatment are so similar that the analogy appears complete.

The authors believe that the two diseases are essentially traumatic, resulting from a strain of the patellar ligament which is in itself potentially strong but in both Osgood-Schlatter's and Larsen-Johansson's disease is attached below or above into a weak point of anchorage.

The diagnosis is based essentially upon the finding of a definite circumscribed point of tenderness over the lower tip of the patella and the detection by roentgenological examination of a separate center of ossification at this site. This case emphasizes the value of giving due recognition to the common physical sign of a sharply defined point of localized tenderness and the necessity for careful investigation for the cause of the tenderness.

The late Dr. Lewis A. Stimson for many years emphasized the importance of the sign of local tenderness in diagnosis, pointing out that this physical test was the most valuable one in detecting a fracture. Sometimes the only sign present and the test which most accurately defined the site of the fracture. He was an acknowledged genius in localizing injuries of the bones by physical examination.

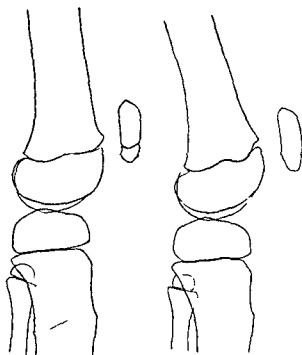


Fig. 3. Case 2. Roentgenogram tracings of both knees, December, 1927. In the left knee the patella shows a well marked anomalous center of ossification at the lower pole. There is also an impacted fracture through the head of the tibia. The patella of the right knee is normal.

In the authors opinion the meticulous examination for the detection of localized tenderness has been productive of bringing to light many lesions which were previously poorly understood, such as epicondylitis of the elbow, strain of the rhomboid muscles at their attachment to the scapula, fractures of the bones of the carpus and tarsus, sprain of the gluteal muscles and similar lesions. We believe that it is not illogical to suppose that beneath a sharply defined point of local tenderness over muscles, ligaments or bones there exists a definite injury to one of these structures (in the absence of any infectious process or disease) especially with the history of trauma, indulgence in active forms of sport or an occupation where unusual strain is exerted on a certain part of the body. This point of view and the habit of attempting accurately to localize points of tenderness perhaps sometimes overdone were responsible in this instance for the detection of the lesion.

### ADDITIONAL CASE REPORTS

More recently another case of this affection was discovered in a boy who sustained a greenstick fracture of the upper end of the tibia with almost no

deformity. He had stepped in a hole and fallen subjecting his knee to a sudden severe strain. He continued to walk for several days but with a considerable limp which did not improve. He then consulted the family physician who found a line of cleavage at the lower pole of the patella as determined by a roentgenogram (Fig. 3) and made the diagnosis of fracture of the patella. He was referred to us on November 14, 1927. On first examination the symptoms were all referred to the patella and there was distinct local tenderness over its lower pole. More careful examination demonstrated in addition a greenstick fracture of the upper end of the tibia. It was an interesting fact however that the degree of tenderness over the site of fracture was much less acute than over the lower margin of the patella and that the disability to all appearances was due to weakness of the attachment of the patellar ligament to the patella rather than to the fracture which was firmly impacted and produced sufficient stability for eight weeks.

#### TERMINOLOGY

The authors have taken the liberty of designating this lesion as Larsen Johansson's disease of the Patella. They have done so with the idea of conforming to modern usage as exemplified by the accepted terms Osgood Schlatter's disease of the tibial tubercle, Koehler's (I) disease of the tarsal scaphoid, Legg Perthes (15 and 19) disease of the femoral head and Kienboeck's (11) disease of the carpal semilunar first described in English by Dr. Kellogg Speed.

#### BIBLIOGRAPHY

- ADAM d LARD Ale el pme t la m ly fthe  
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- 2 ALSBORG Zt l f o th p Ch r 9 8 3  
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5 L A B t M & S J 9 cl 4  
6 LEVIN Apophy t f th o c leis S rg Gynec &  
Ob t 9 5 l 579-58  
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# CLINICAL SURGERY

FROM THE NEUROSURGICAL CLINIC OF THE UNIVERSITY HOSPITAL

## THE RADICAL OPERATION FOR THE RELIEF OF TRIGEMINAL NEURALGIA

By CHARLES H. HAZHIF, M.D., SC.D., F.A.C.S., AND W. J. GARDNER, M.D., PHILADELPHIA

SINCE 1908 when Spiller first proposed section of the sensory root as a substitute for excision of the Gasserian ganglion the sensory root operation has been the accepted procedure the world over. However certain modifications have been made in the operative details since that time. In 1918 it was proposed and the suggestion has since been accepted that the motor root should be conserved. Still later it was found unnecessary to sacrifice the entire sensory root so that what has come to be called "subtotal section of the root" is now accepted as the proper procedure. For example if the pain is not referred to the ophthalmic distribution the inner fibers of the root are not divided. The importance of this innovation in absolutely eliminating trophic keratitis only needs be mentioned.

The operation carries with it unqualified assurance against recurrence; the hazards of the operation have been so reduced that the mortality rate is less than one half of 1 per cent.

Generally speaking there is no operative field with more frequent anatomical variations with more variations as to amount of hemorrhage and with a wider range as to what might be regarded as an operation devoid of any great technical difficulty. It is so beset with puzzling situations that only with a background of wide experience can one approach the next operation

with a sense of confidence. Even with an experience of 520 operations in the Neurosurgical Clinic of the University Hospital certain new pictures present themselves.

### PREPARATION OF PATIENT

A careful physical examination is made including a renal function test. A blood pressure observation is made in all cases. When the blood pressure is 100 or over the patient may receive an alcoholic injection. With rest and relief of pain the blood pressure is often reduced. Again an alcoholic injection may be given as preliminary treatment when because of pain on swallowing the patient may be improperly nourished or from lack of sleep exhausted. A week of rest with proper attention to diet and water intake has a very beneficial effect.

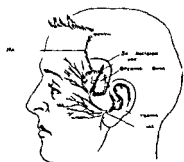


Fig 1 The relationship of facial nerve to incision left side

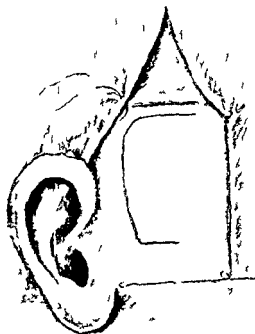
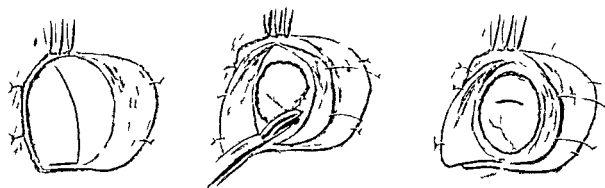


Fig 2 Location of skin incision with relation to ear right side



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nd m l h t l b B f m l l m f t l t t

As a precaution against keratitis a drop of 1 per cent solution of atropin sulphate is instilled in the eye the night before and the morning of the operation.

The hair is shaved only from the temple about 8 centimeters above the zygoma and posteriorly to a perpendicular line through the mastoid process. Twenty minutes before the operation the patient is given the usual preoperative hypodermic: 6 grain of morphine sulphate and 1 to 1.50 grain of atropin sulphate.

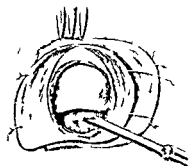
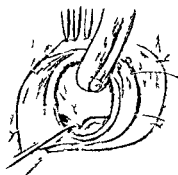
#### THE OPERATION

The various steps of the operation are depicted in the accompanying illustrations. As one sees the structures on the operating table the illustrations do not seem to portray the picture faithfully. In various attempts to secure accurate reproductions the artists have failed to give the proper perspective and seem unable to repre-

sent the anatomical details accurately. However the illustrations here reproduced will serve at least as a guide to the text.

*Position of the patient.*—Reference is given to the sitting position for several reasons: there is less blood flow, the patient requires less ether and the field of operation is on a level with the eyes of the operator.

*Anesthesia.*—The anesthetic of choice is ether administered by the open drop method. The anesthesia is begun while the operative field is being prepared and generally the patient is anesthetized by the time the draperies are in position. As soon as the ganglion is exposed it is injected with a cubic centimeter of 2 per cent solution of novocain; the ether is continued and the operation carried under regional anesthesia. The time consumed in exposing the ganglion is usually about 10 minutes so that but little ether is required. This operation might



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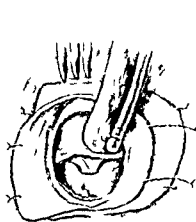


Fig. 3 The third division is exposed and dura separated from superior surface of ganglion



Fig. 5 A horizontal incision in dura beneath of ganglion (larger scale)



Fig. 8 Dural sheath of one of the first and second division indicated by dotted line (larger scale)

quite well be performed under local anesthesia but a general anesthetic is preferred by the patient. Subjects of trigeminal neuralgia usually have reached the limit of human endurance and dread the thought of additional discomfort. The use of ether in such small quantities in no way adds to the risk of operation.

The cutaneous incision is composed of a horizontal limb a little over 1 centimeter in length along the superior border of the zygoma and about half a centimeter in advance of the tragus of the ear and of a vertical limb extending upward about 4.5 and curving forward 2 centimeters (Fig. 1). It is secured by the assistant on the temporal artery where it crosses the zygoma will keep the field bloodless while the cutaneous incision is being made. As the temporal artery is cut across in the lower horizontal limb it is grasped with a hemostat. The resulting skin flap is dissected free of the underlying tissue reflected forward and sutured to the draperies thus avoiding the use of a self-retaining retractor (Fig. 2).

**Musculo aponeurotic incision.** An incision is made in the temporal fascia and muscle—just the reverse of the cutaneous incision (Fig. 3). The resulting musculo aponeurotic flap after it has been separated with the pericranium from the temporal bone is reflected backward and sutured to the draperies. Thus a sufficient area of temporal bone is exposed without the use of retractors. This incision is so designed to be quite within the hair line and to avoid injury to the superior branch of the facial nerve.

**Removal of bone.** A small perforation in the skull is made with hammer and chisel below the level of the middle meningeal artery and the

opening enlarged with rongeur forceps (Fig. 4). An opening 4 centimeters in diameter usually is ample. The lower margin of the opening must correspond to the base of the skull.

**Separation of dura.** The separation of the dura from the skull without laceration may be very difficult especially as one approaches the base of the skull where it is most adherent and of most delicate texture. When the dura is snugly adherent it is advisable to begin the separation on either side of the cranial defect. A small perforation is made in the dura in the center of the exposure to allow the escape of cerebrospinal fluid throughout the operation (Fig. 5). This reduces the bulk of the intracranial contents and thus facilitates the elevation of the temporal lobe. With gentle pressure by means of an illuminated brain retractor especially designed for this operation the operator commences to separate the dura from the floor of the middle fossa. Usually this is readily accomplished with a septal elevator but occasionally the dura is so adherent that lacerations of the dura may be unavoidable.

The operative field at this stage is kept bloodless by means of a specially designed curved metal aspirator and by the judicious use of dental cotton tampons.

**Approach to the ganglion.** The first landmark is the groove of the middle meningeal artery on the floor of the fossa. When this is seen the operator follows it to its termination at the foramen spinosum where the dura is separated gently to avoid rupture of the artery sufficiently far and aft of the foramen to permit a clear view of the artery as it emerges from the foramen. The middle meningeal artery and foramen is thus exposed with a small dental applicator and the



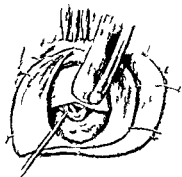


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(lag s l)

Fig 7 Th t tw th l f th s y o t  
p k d p hook ly f t n M t oot b h d

foramen is plugged with a wisp of cotton so as to obliterate its lumen (Fig 6) The artery and vein are then divided with a scalpel

*Exposure of the ganglion* The next objective is the mandibular division of the trigeminal nerve as it enters the foramen ovale This foramen lies just mesial and a little anterior to the foramen spinosum and is partly hidden from view by a small bony eminence on the floor of the fossa This eminence is removed with a chisel (Fig 7)

The next step of the operation is the most important and sometimes the most difficult The dura must be separated from the sheath of the ganglion Often the line of cleavage is difficult to find or the dura may be intensely adherent to the ganglion's sheath One must avoid perforating the dura or penetrating the sheath For this separation a septal elevator combined with a suction apparatus all in one will be found helpful and pressure is made directly over the foramen ovale until this line of cleavage becomes manifest (Fig 8) The dura is separated from the surface of the ganglionic sheath as far forward as the maxillary division and backward and inward until the arachnoid covering of the sensory root comes into view One cubic centimeter of percent cocaine is injected into the ganglion the ether is discontinued and the operation concluded under regional anesthesia

*Exposure of the cranial root* One should be familiar with the appearance of the line of junction between the ganglion and root It is usually readily recognized in various ways and the dura must be dissected far enough mesad so that an ample exposure of the root may be obtained The facility with which fractional division of the root

is accomplished will depend upon the liberality of this exposure Without such exposure the nicety of the subsequent steps is an impossibility To expose the root an oblique incision is made in the dural sheath parallel and a little in front of the posterior margin of the ganglion (Fig 8 a) The sheath is bluntly separated on either side of this incision and the sensory root is exposed to view (Fig 8 b)

*Exposure of the motor root* When the sensory root is elevated the motor root may be seen on the floor of the skull as a separate isolated fasciculus Sometimes the motor root is composed of two fasciculi It is quite separate and distinct from the sensory root and may be seen to pass behind the ganglion If there is any question about its identity it may be identified by stimulation with an electrode (Fig 9)

*Section of the sensory root* There remains now only to section as much of the root as may be required in the individual case The upper and inner third of the root supplies the ophthalmic division the lower and outer third the mandibular division and the intermediate fibers the maxillary division As in most cases pain is referred to the maxillary and mandibular divisions this portion of the root must be sacrificed Section of the necessary fasciculi is readily accomplished with a small scalpel after the fasciculi have been isolated on a specially designed blunt hook (Fig 10)

*Hemostasis* There are only three sources of hemorrhage that may require attention (1) A small dural sinus which may be injured when the dura is separated from ganglion in the neighborhood of the second division To control this a tiny muscle graft is sufficient (2) The peripheral stumps of the middle meningeal vessels which

are clamped with two Mackenzie silver clips (3) Oozing from the middle meningeal artery in its groove in the antero inferior angle of the parietal bone To control this it is usually sufficient to separate vessel and dura entirely free from the skull at this point

*Wound closure* Bleeding no matter how slight should be completely controlled before the wound is closed The tiny dural incision and any incidental laceration of the dura should be sutured The wound is then closed with interrupted sutures in each tier temporal muscle temporal aponeurosis galea and skin

#### POSTOPERATIVE CARE

The immediate convalescence as a rule is free from any great discomfort Sometimes nausea

and vomiting may disturb the patient for 24 hours These are probably of central origin and are not affected by medication Five hundred cubic centimeters of a 5 per cent solution of glucose is given by enteroclysis should there have been much oozing during the operation A postoperative headache will yield to aspirin or codein If the entire root has been sacrificed corneal complications may be prevented by keeping the lids closed and continuing the installation of atropin for 4 days with irrigations of boric acid solution 3 times a day The head and shoulders are slightly elevated A cathartic is given on the evening of the first postoperative day and an enema in the morning The patient is allowed to get up on the fifth day when the stitches are removed





## FROM THE DIVISION OF SUICIDE MEDICINE

## AN ASEPTIC METHOD OF INTESTINAL ANASTOMOSIS

J. HEDW. LANKIN, M.D., F.A.C.S., M.

THE most fascinating chapter in the repertoire of surgical work with primitive man or even the great intestinal tract. In this chapter the paragraph of intestinal anastomosis represents the most intricate level of the surgical art from the technical standpoint. The earnest endeavor of many men in the factor of safety in intestinal anastomosis is the same as in the field which will produce the removal of the intestinal lesion for the restoration of physiological equilibrium with its stimulation and with the low mortality and morbidity. The multiplicity of procedures and the full development of the technique to satisfy the interest in such a nature. The level of a plain type of anastomosis has been used in multiple levels and in the many of which recommend them clearly with the various success and many because of their technical complexity are do much better.

Kerr in a classical paper called for the Section on Surgery of the American Medical Association in 1901 traced the development of intestinal surgery from the earliest records up to the present time. He mentioned in his *Synopsis of the Puller's* and his *History of the Treatment of Intestinal and Colic* that the type of suture for the application in the intestine is the central point in recovery from intestinal perforation. A small battle wound or a central perforation has resulted from the anastomosis of the peritoneal cavity of the intestine to the peritoneal cavity. A recent effort in the continuation of the Travers puller's series of experiments on animal in that intestinal anastomosis has been a glutinous and alkaline substance the fact that the procedure has been known to the medical profession for more than four hundred years. The use of the peritoneal cavity of the venter in 1800 by Ant. de Lamberet of Paris whose name is still associated with intestinal suture put into practice the principle that intestinal anastomosis is a lesion of the inverted peritoneal cavity thus a fundamental principle established which has been largely responsible for the successful evolution of this branch of surgery. Murphy, but in 1899

marked another advance subsequent to which intestinal resection became popularized. Kerr reported that there have been about 250 different methods of intestinal sutures described in the last century and he himself offered a most admirable practical method which answers all the fundamental requirements and is really a simple one. His "Lambert" stitch method has proved very satisfactory in my hand. I feel sure that it is one of the most satisfactory types of intestinal anastomosis.

Kerr stated that after Hults's pioneer attempt to develop a practical method following the method of the thirty-two separate and distinct methods have been proposed. Failure of the method to be generally adopted is due mainly to four reasons: (1) the disregard of many vital fundamental principles of intestinal surgery in the desire to accomplish a perfect procedure; (2) the lack of simplicity in method; (3) the lack of precluded anatomical difference; (4) the inadequate vascularization to the resected end; (5) the lack of cause of the necessary method of joining the bowel and (6) failure to recognize that the three bowel in which three-fourths of the resections are necessary for removal of highly permeable under obstructive conditions and that its manipulation is not followed by peritoneal contamination due to the great exposure through the bowel wall but the fact that the resection and anastomosis have been done in a thoroughly aseptic manner.

The difference in the anatomical construction of the large and small portions of the bowel influences considerably the technical maneuvers applicable to each. The large bowel is much thicker than the small bowel and its tunica propria is beneath the endothelial layer of the epithelium and which contains lymphatics and blood vessels is often replaced by fat. Under the most favorable conditions its normal permeability greatly increases and absorption and infection take place. The peristaltic action of the large bowel is infinitely more powerful than that of the small bowel so there is more likelihood that strain on the suture line will cause leakage.

The blood supply of the large bowel in each of its divisions is often inconstant and the anastomosis is frequently uncertain. The right half

around to the middle of the transverse colon receives its blood supply from the superior mesenteric vessels together with the rest of the absorptive portion of the gastro-intestinal tract and the left half which is concerned mostly with storage receives its blood supply from the inferior mesenteric branches of the aorta. The anastomosis between the two sources of supply is often incomplete or absent and for this reason failure of union with resulting necrosis and peritonitis may occur when the resection has been made in the distal arm of the transverse colon or the upper part of the descending segment. Another source of failure in the open method of intestinal anastomosis has been the invasion of the fat of the mesentery in the V where a wedge has been excised. Here necrosis is probably most frequently walled off and occasionally rupture through the suture line occurs into the lumen of the bowel but more often abscesses result from leakage infection and failure of the anastomosis.

The healing of intestinal wounds has been splendidly dealt with experimentally by Hulstet Mall Hertzler and others. Regenerative change according to their experiments demonstrate that the healing of the peritoneal wound takes place by direct transformation of lymph into connective tissue without passing through the granulation tissue stage if there is no infection. Agglutination of the resected ends under firm pressure is another principle of intestinal surgery which is advantageously employed in making a clean closed anastomosis. Mall's experiments showed that under pressure the diaphragm which is a result of turning in the margins becomes destroyed by necrosis and at the end of the fifth day the slough separates leaving usually a clean surface. The muscularis mucosa is completely regenerated at the end of about 3 weeks and the raw surfaces of the anastomosis are covered over. The sloughing away of this diaphragm sometimes has been accompanied by secondary hemorrhage occasionally fatal but this is an exceptionally rare complication. Quick healing of intestinal wounds is due to approximation of the peritoneal surfaces and inserting suture material only deep enough to catch the submucosa which is the important structure in the anastomosis (Figs 1 and 2).

The clamp which I have devised I offer not with easy confidence that it will be adaptable for intestinal anastomosis under all conditions and circumstances but with the hope that it may be a valuable addition to the surgeon's armamentarium. I feel that the simplicity of its arrangement and the ease with which it may be applied and manipulated commend it. I have found it ex-

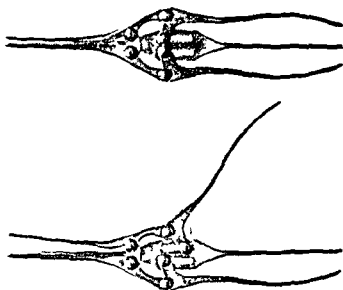


Fig. (1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11) (12) (13) (14) (15) (16) (17) (18) (19) (20) (21) (22) (23) (24) (25) (26) (27) (28) (29) (30) (31) (32) (33) (34) (35) (36) (37) (38) (39) (40) (41) (42) (43) (44) (45) (46) (47) (48) (49) (50) (51) (52) (53) (54) (55) (56) (57) (58) (59) (60) (61) (62) (63) (64) (65) (66) (67) (68) (69) (70) (71) (72) (73) (74) (75) (76) (77) (78) (79) (80) (81) (82) (83) (84) (85) (86) (87) (88) (89) (90) (91) (92) (93) (94) (95) (96) (97) (98) (99) (100) (101) (102) (103) (104) (105) (106) (107) (108) (109) (110) (111) (112) (113) (114) (115) (116) (117) (118) (119) (120) (121) (122) (123) (124) (125) (126) (127) (128) (129) (130) (131) (132) (133) (134) (135) (136) (137) (138) (139) (140) (141) (142) (143) (144) (145) (146) (147) (148) (149) (150) (151) (152) (153) (154) (155) (156) (157) (158) (159) (160) (161) (162) (163) (164) (165) (166) (167) (168) (169) (170) (171) (172) (173) (174) (175) (176) (177) (178) (179) (180) (181) (182) (183) (184) 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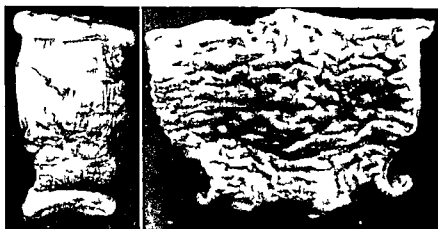


Fig 3 (left) Intestinal anastomosis in the dog. Sp m p d Ab f b l  
w l ed t p t l t l ty f b o l  
Γ 4 Sp m l C m l t l c f l ph m t t f p t

The results of the foregoing experiments are clean cut. In the first control group all of the animals died of peritonitis within 5 days. In the second group there were no evidences of peritonitis and there were no deaths. Observations at subsequent operations 6 to 8 weeks later revealed that the anastomosis functioned satisfactorily, the bowel was not dilated proximal to the anastomosis. A study of the operative sites after their removal from the body indicated these facts: absence of circular constriction, almost complete absence of a diaphragm within the lumen and absence of diminution in the diameter of the lumen.

Such results prompt the conclusion that the clamp under consideration offers an entirely satisfactory closed aseptic method for anastomosing the large bowel in the dog. Furthermore it is readily conceivable that the clamp should be even more applicable to operative procedures in man when one considers that the preceding results were obtained in spite of certain handicaps that the intestine of the dog offers to such procedures, namely its relative smallness, thickness, friability, and tendency to contract on manipulation.

The instrument is a three-bladed clamp sufficiently short to facilitate adaptability. It is readily mobile and narrow enough to permit the



Fig 5 Edited intestinal anastomosis in the dog. Sp m h t b  
p d

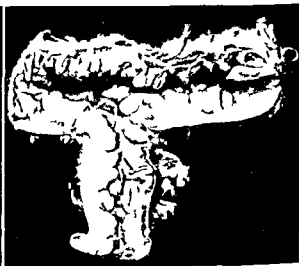


Fig 6 Segments of large bowel anastomosis in the dog. Sp m h t b  
p l t a b c f d i p h g m t s t o f p t n C m

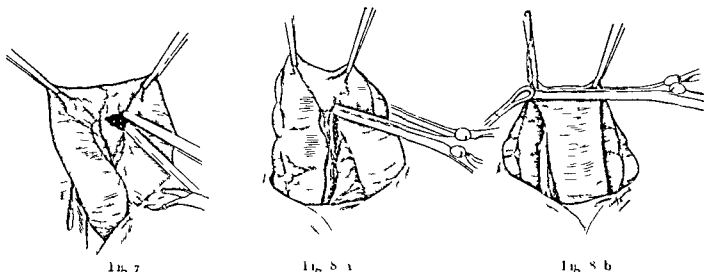


Fig. 7 Application of clamp to ilium. The blood supply in the mesentery has been tied off and the clamp is applied at an angle so as to divide the lumen for the anastomosis. The bowel is divided with cautery.

Fig. 8a The clamp is being applied to a point selected on the transverse colon for the colonic end of the anastomosis. An elliptical portion of the colon is being removed by cautery to make an opening in its lumen and the small bowel is shown approximated at this point.

advantage of the principle of agglutination between the peritoneal coats of the crushed bowel and at the same time to avoid excessive clamping which comes from the attempt to suture over a wide instrument. The central blade is the fixed point against which the two lateral blades operate independently. The fulcrum which permits the steady pressure is in the handle; there is a fulcrum on each side of the clamp. The length of the entire clamp from tip to tip is 2.5 centimeters. Each blade is 7.5 centimeters long and the central blade is 0.5 centimeters wide. It is 3 millimeters deep and the blade portion when closed is 8 millimeters deep. When the clamp is in use the posterior peritoneal coats of the two arms of the bowel are in direct approximation separated only 0.5 centimeters by the central blade and the anterior surfaces of the two limbs of bowel to be anastomosed are separated by the entire thickness of the clamp. Firm pressure and agglutination keep the limbs of the resected ends in accurate apposition after the application of the suture which covers the point of the clamp but which necessarily is not drawn tight over the handle portion until its withdrawal. On withdrawal of the clamp the end suture is put in and the whole line of sutures on the anterior surface is drawn taut without contamination. The diaphragm must be broken out with the fingers through the lumen.

Control of hemorrhage is dependent on the crushing of the vessels and occasionally perhaps secondary hemorrhage may take place. It has not occurred in the cases in which I have used the clamp and I believe that it is a much overesti-

mated danger in closed anastomosis. The formation of a diaphragm after operation has not been observed in the experimental laboratory or in a series of resections on human beings.

It may be well to discuss the three types of anastomosis somewhat more in detail. In an operation on the large bowel for carcinoma or any other lesion that has produced long standing obstruction the two stage resection should practically always be performed. I am convinced that this should always be carried out in the left segment of the colon but certain conditions in the right segment may make it advisable to perform the one stage operation. However carcinoma in either arm of the colon presents a somewhat different problem from tuberculosis stasis or other lesions that require surgical intervention and since surgery of the colon is usually directed toward the eradication of malignancy I have gradually come to believe that all carcinomata of the colon if they are causing any obstruction whatever should be operated on in two stages.

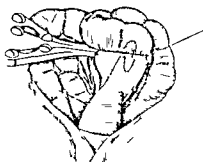


Fig. 9 Posterior layer of sutures being applied in end to side anastomosis. Clamp is turned over.



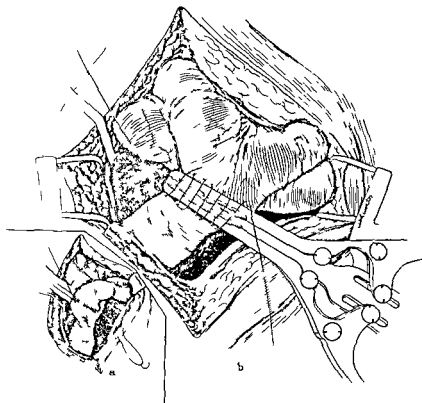


Fig. 11. Ileocolostomy. The clamp is put on the small bowel at an angle and the bowel is cut across the end toward the cæcum being invaginated by a purse-string suture and dropped back to be removed with the colon at the subsequent resection. An elliptical piece of the transverse colon is removed with the cautery after the application of the clamp to the selected site. The clamp and the mobility of the bowel permit easy handling and the sutures are first put in on the posterior side of the bowel which may be brought under the eye by turning over the whole clamp. This permits the accurate approximation of the peritoneal coats of the bowel on the under surface of the anastomosis because here the two arms of the bowel are in juxtaposition. After this suture is in place the clamp is again reversed and the anterior line of sutures applied in a manner identical with that employed in closing the duodenum following partial gastric resection. The sutures at one end of the clamp have drawn the bowel together over this end and the clamp is now released and with drawn. The agglutination of the two ends of bowel under the steady pressure keeps it intact.

### ILEOCOLOSTOMY

I have used the clamp in performing ileocolostomy in the right half of the colon between a suitable site in the transverse colon and a point in the ileum about 3 centimeters from the ileocecal

valve. In order to secure as large an opening as is desirable the clamp is put on the small bowel at an angle and the bowel is cut across the end toward the cæcum being invaginated by a purse-string suture and dropped back to be removed with the colon at the subsequent resection. An elliptical piece of the transverse colon is removed with the cautery after the application of the clamp to the selected site. The clamp and the mobility of the bowel permit easy handling and the sutures are first put in on the posterior side of the bowel which may be brought under the eye by turning over the whole clamp. This permits the accurate approximation of the peritoneal coats of the bowel on the under surface of the anastomosis because here the two arms of the bowel are in juxtaposition. After this suture is in place the clamp is again reversed and the anterior line of sutures applied in a manner identical with that employed in closing the duodenum following partial gastric resection. The sutures at one end of the clamp have drawn the bowel together over this end and the clamp is now released and with drawn. The agglutination of the two ends of bowel under the steady pressure keeps it intact.

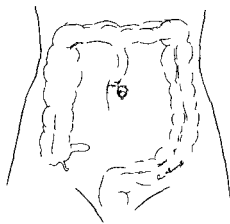


Fig. 12. Operation. The ileum is turned and dropped back to the bottom while the proimileum is drawn into the transverse colon.

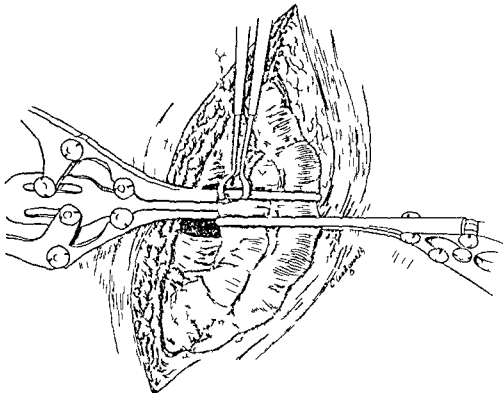


Fig. 12 Division of bowel proximal to the growth one limb of the clamp holding, the end to be anastomosed the other limb shown closed

and the anterior layer of sutures is pulled taut and tied. Leakage at this stage has not occurred in any of my cases. Another layer of silk sutures is inserted around the entire area of anastomosis and the fat tags and omentum are wrapped around it to guard against contamination and leakage. The fingers of one hand are invaginated through the anastomosis to break out the agglutinated ends and prevent obstruction. The secondary resection of the colon takes place in about two weeks.

#### END TO END ANASTOMOSIS

I have usually employed this method of end to end anastomosis in the sigmoid but I applied it in two cases of growths in the descending colon and in one case of carcinoma in the transverse colon. Drainage procedures were carried out in all cases preliminary to the resection and anastomosis. Certain portions of the sigmoid in which more carcinomata occur than in any other segment of the colon offer ideal sites for resection and anastomosis. I am not discussing here the growths low in the sigmoid or in the rectosigmoid because of the questionable desirability of reestablishing the intestinal continuity when carcinoma has invaded this portion of the gastrointestinal tract. One is frequently loath however to make a permanent colostomy in the middle and upper part of the sigmoid and subsequently to

resect all the bowel distal to it in such cases the clamp anastomosis may be carried out most satisfactorily. In this situation one may practically always be certain of the adequacy or inadequacy of the blood supply to both ends since it may actually be seen. The end to end anastomosis is readily accomplished over the clamp in much the same manner as the end to side anastomosis the clamp being put on the bowel with the handle away from the operator thus making the posterior suture line more readily accessible following resection. I have found it advisable in most instances to place the clamp superimposed by a small Payr clamp on the upper end of the bowel to be resected and to cut between the two with the cautery. This permits one to gauge the exact amount of bowel below which may be sacrificed with the possibility of establishing anastomosis without tension and with adequate blood supply to the ends. Having satisfied oneself on these two points a similar maneuver is carried out on the distal end and again the resection with the cautery leaves the bowel ready for anastomosis over the clamp. Occasionally if the bowel is freely movable and inspection can be carried out rapidly both ends of the bowel may be caught in the clamp one clamp being used above for the resection. Fat tissue should be removed from the immediate vicinity of the suture line but once the anastomosis is made such structures as



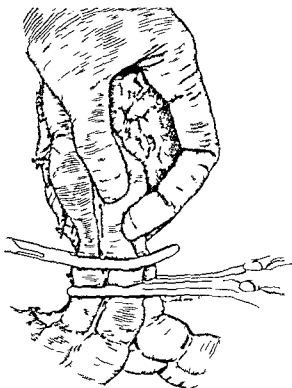


Fig. 14

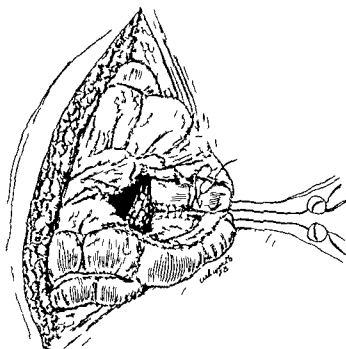


Fig. 15

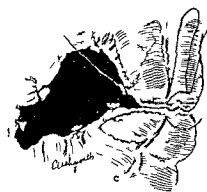
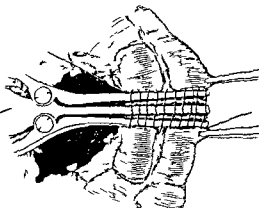
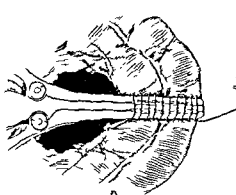


Fig. 16

catgut suture approximates the peritoneal coats of the bowel on the posterior side. This suture extends half way across the bowel.

Fig. 16 End to end anastomosis over clamp. Resection has been made. A suture applied on anterior side of the bowel with continuous peritoneal stitch. b Clamp unlocked ready to be withdrawn after which the suture will be drawn taut inverting the end of the bowel. c Completed operation and final row of sutures being put around the anastomosis.

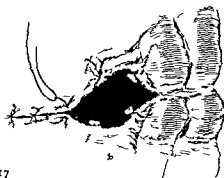
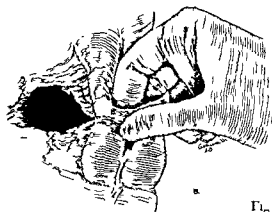


Fig. 17

Fig. 14 Segment ready for removal with cautery. One clamp above the anastomosis line catches both limbs of the bowel to be removed.

Fig. 15 The first layer of sutures is being applied posteriorly. Clamp is rotated laterally and a continuous

Fig. 17 a The final row of sutures introduced through the anastomosis to break up the agglutination which forms a diaphragm. b The operation is completed with two layers of sutures. Closure of the rent in the mesentery is made with interrupted catgut sutures.



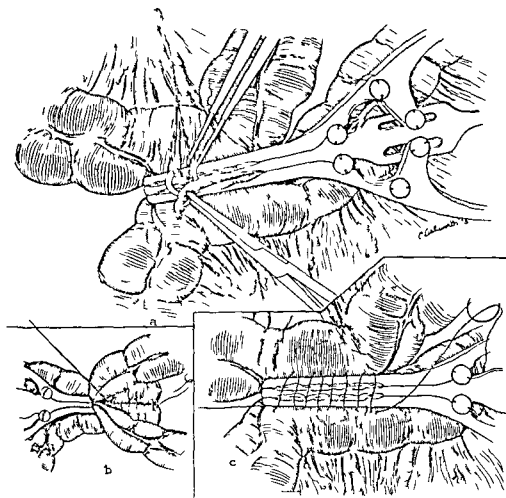


Fig 19 Colocolostomy a Opening in two segments of bowel being made with cautery b Posterior suture line c Anterior suture line

tion it did not moreover sacrifice the blood supply to the segment. Failure to observe these two criteria have resulted in the application of the procedure to many cases in which it was totally contra indicated and the violation of the principles that growths in the colon that are adherent infected and permeable may not be handled except with the gravest likelihood of peritoneal contamination. It is applicable to a small scirrhus growth without glandular metastasis which occurs in a mobile segment of the bowel particularly the sigmoid and which may be brought outside the abdomen without handling or difficult mobilization and sacrifice of blood supply. In elderly patients and in patients in whom the risk is great it is distinctly useful but for the average large growths which must be mobilized and handled and from which contamination is feared by spread of organisms throughout the peritoneal cavity the substitution of colostomy or some drainage procedure and subsequent resection with anastomosis has resulted in my hands at least in an enormous lowering of

the mortality rate and in more satisfactory operative results than when the Mikulicz procedure was used. It is an axiom that the highest mortality attendant on all types of operations on the colon follows operation on the transverse colon where the growths are more easily accessible. The reason for this is clear. In all likelihood because of the accessibility of the growth primary resection is most often attempted. Failure results from two main causes first inadequate blood supply and second peritonitis from direct contamination from the growth at the time of resection.

Since January of this year (1928) I have performed this operation in 5 cases in which the clamp was left on without failure. The safety of this operation is due I believe to adequate preoperative preparation the use of spinal anesthesia and the selection of cases in which the operation may be performed without submitting patients to tedious and difficult procedures of mobilization. In cases of obstruction to the colon if segregation and proper preparation from

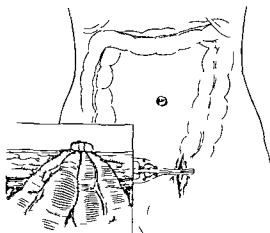


Fig. 1. Obturator type of clamp. The clamp is applied to the bowel through the abdominal wall. The clamp is made of two pieces of metal, one of which is inserted into the abdominal wall and the other is applied to the bowel. The clamp is held in place by a suture.

the standpoint of cleansing the bowel and rehabilitation is instituted the obstructive type of operation may be frequently performed (in the transverse segment and the sigmoid) leaving the clamps on 4 days without inconvenience to the patient from the obstruction.

Usually for 4 hours and often for 36 hours or longer following a spinal anesthetic and resection the bowel is in a state of paralysis and there is little or no tendency to the formation of gas and distention. Total abstinence from food and drink by mouth increases the likelihood of the patient's being carried through 4 days without discomfort. Fluids are supplied subcutaneously or intravenously thus keeping the water balance normal. The thirst of which the patient usually complains is allayed by small sips of water after the first 4 hours or by sucking a lemon or orange occasionally. The advantage of the clamp in this procedure is that the bowel which should be brought well out of the abdomen so as to insure adequate blood supply may be opened on its proximal side should distention and discomfort demand it after the first 36 hours. The peritoneum is sutured snugly around the bowel but sutures are not placed in the wall of the bowel. When the clamp is removed entirely in this type

of resection a spur remains which may be cut out by the application of clamps after about 2 weeks it remains then merely to close the colostomy opening in the ordinary manner to complete the maneuver. I have found that when the diaphragm is cut through widely following these exteriorization procedures closure takes place spontaneously in a high percentage of cases.

I am convinced that successful outcome following resection and anastomosis of the large bowel especially in malignant cases depends more on a leisurely pre-operative preparation and rehabilitation measures than on technical procedures however highly desirable the latter may be. In regard for the fact that virulent organisms have a normal habitat in the large bowel in increasing in number and virulence under certain untoward conditions if obstruction is present perhaps operates more against successful outcome in any type of mechanical procedure than any other consideration. Consequently adequate pre-operative preparation of the bowel consisting of drainage procedures after the institution of measures to cleanse the bowel and the routine establishment of a proper diet consisting mostly of carbohydrates and fruit juices which leave little residue increase markedly the chances of satisfactory recovery. Grade I operation under spinal anesthesia likewise have been highly satisfactory departures from the usual routine. Selection of cases for resection and the judgment to refuse to operate in hopelessly advanced cases will lower the operative mortality in the whole group and I believe will result in a higher percentage of cures in a given number of cases than the tendency to press the operation in every instance in which the results are uncertain. In creating the horizon of operability and the institution of more radical measures for resection may be accomplished only by attention to minute detail and I believe it is in this field that an aseptic type of resection is feasible while but an incident in the successful operative management of the cases possesses many advantages.

#### BIBLIOGRAPHY

- I. R. J. V. L. f. th. J. d. m. thod. n. t.
- II. W. S. Bl. J. d. l. t. f. th.
- ph. km. p. t. l. w. th. k. f. t. od. ed. p.
- t. m. A. S. g. o. l. 356 364
- J. k. H. H. l. h. d. l. pm. t. f. nt. t. l. g. y.
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## ARTHROPLASTY OF THE KNEE

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**R**ESTORATION of function by arthroplasty and subsequent treatment is a more intricate problem in the knee than in other joints. This is due to the fact that the knee is the most complex articulation in the body and is dependent for stability upon ligamentous support on all four sides and in the interior of the joint.

In June, 1911, the author's first report was made on arthroplasty of the knee before the American Orthopedic Association and in January, 1913, a further report was made before the Orthopedic Section of the New York Academy of Medicine. In the first report, including 4 cases, the results were far from satisfactory. In the second, 16 more cases were discussed, which showed a marked increase in percentage of good results. Since the second report, there have been 11 additional arthroplasties of the knee, or a total of 111 cases, and sufficient time has elapsed to determine the actual character, stamina, and durability in a large number of cases in which function has been restored. This after all is the real test of the value of the procedure.

Arthroplasty is an operation for the replacement of function to an ankylized joint by the reconstruction not only of the bones but of all of the component parts—the muscles, ligaments, tendons and fasciæ. The operation is only the first step in the program of restoration of function as careful systematic after treatment is essential to success.

Differentiation between the types of ankylosis is of no practical value, although it is important to distinguish the degree of fusion, the prognosis and treatment in fibrous and bony ankylosis is identical. Periarticular restriction of motion is considered only as a complication of either type.

The indications, contra-indications, and limitations of the procedure vary to some extent in the different joints, but in the knee they may be enumerated as follows:

1. Arthroplasty may be considered routinely only when two conditions—acute pyogenic infection and trauma—are the causative agents of ankylosis or restricted motion. It has been found that the etiology in a very large percentage is an infection by pyogenic organisms such as the streptococcus, staphylococcus, gonococcus, and pneumococcus. These organisms in primary intra-articular infections erode and disintegrate the

cartilage and superficial bone from within but do not invade the shaft to an extensive degree. That all evidence of acute infection must have subsided before an operation is performed is such a well known surgical maxim as hardly to be worthy of mention. Trauma or the crushing of joint surfaces, tearing of the periosteum and multiple fractures are so seldom causative agents of complete ankylosis in the knee as to be almost negligible. However, when incongruity of a joint following comminuted fractures causes pain on movement, arthroplasty is indicated although a considerable range of motion may be present.

Multiple ankylosis, even as the result of a pyogenic infection, obviously renders the problem more difficult and the prognosis less certain as the important after treatment to restore function may be inhibited by ankylosis of other joints.

3. In monarticular tuberculous joints, operative procedures within the joint are seldom indicated because of the probability of lighting up a latent tuberculous infection. In ankylosis of both knees, the disability is so great that even the risk of a recurrence of tuberculous infection is warranted. In tuberculosis of the knee, solid osseous fusion is rare; however, in those in which osseous fusion has been induced in the early stage of the infection by open operation before extensive destructive changes have occurred, there is greater probability of eradication of the pathological process. It is therefore conceivable that in future years arthroplasty will be increasingly indicated in cases of this type and the scope of the procedure in the knee will be materially enlarged.

4. Arthroplasty may be employed in low grade progressive arthritis such as rheumatoid arthritis and arthritis deformans, but the prognosis is not favorable and at present the procedure in such cases is in an experimental stage.

5. Position is an important factor. Ankylosis in full extension or not over 30-degree flexion is more favorable to arthroplasty. Flexion contracture of over 80 degrees renders the result more uncertain.

6. Shortening of more than 3 inches as a result of destruction of bone or lack of growth contra-indicates mobilization, as further excision of bone would be required and the end would not justify the means.

7. Abnormal osseous structure, as demonstrated by the X-ray, may be an important factor





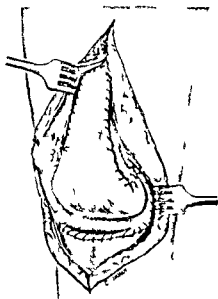


Fig. 4

Fig. 4 The new joint has been lined with a free transplant of fascia lata which forms a double layer between tibia and femur. It is sutured deep in posterior compartment of joint and covers anterior surface of femur.

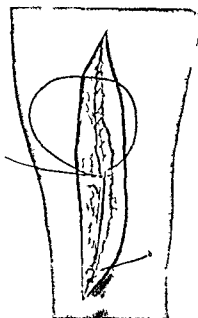


Fig. 5

Fig. 5 The deep and superficial fasciae are closed by continuous sutures.

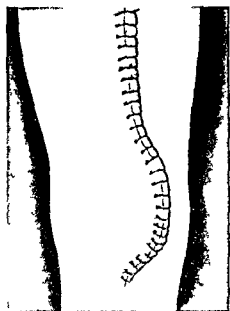


Fig. 6

Fig. 6 The skin is closed in the routine manner.

#### TECHNIQUE

In our first cases we attempted to remodel the joint so that it would conform anatomically with the normal articulation, but we met with a number of failures. We have therefore devised a more simple procedure which will induce function without regard to anatomical detail.

In remodeling the knee joint, no routine technique is applicable to all cases; the procedure must be modified to accommodate the following conditions:

1. Position (a) extension or slight flexion (b) flexion with and without external rotation and valgus
2. Distribution of ankylosis (a) panankylosis or complete bony fusion of the patella, femur and tibia, which occurs most frequently (b) fusion of patella and femur with apparently normal tibiofemoral articulation (c) tibiofemoral fusion with a freely movable patella.

#### PANANKYLOSIS IN EXTENSION

An Esmarch bandage and tourniquet are applied on the upper third of the thigh in order to make the field of operation bloodless. The incision is begun from 4 to 6 inches above the knee at the outer border of the quadriceps tendon and extended downward with slight convexity inward parallel to the medial aspect of this tendon, terminating just below the attachment of the patellar tendon to the tibia. The skin and superficial and deep fasciae are incised; the incision then passes through the junction of the quadriceps tendon and the vastus internus muscle. Dissection is made to free the quadriceps tendon from the femur and the bony union between the patella and femur is chiseled loose. All ligamentous struc-

lar tendon to the tibia. The skin and superficial and deep fasciae are incised; the incision then passes through the junction of the quadriceps tendon and the vastus internus muscle. Dissection is made to free the quadriceps tendon from the femur and the bony union between the patella and femur is chiseled loose. All ligamentous struc-

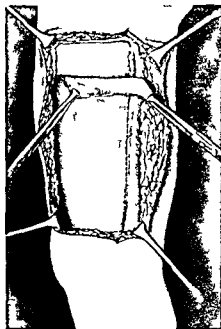
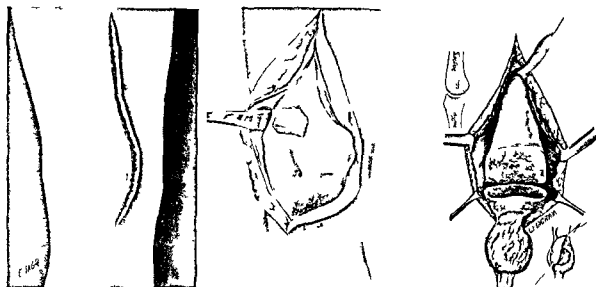


Fig. 7 A free transplant of fascia lata is removed from the opposite thigh.



F g                      F  
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in determining the prognosis and indications for arthroplasty. The chances of success are decreased when the structure has been transformed for 1 or more inches adjacent to the articular surfaces. Old dense eburnated bone when found for a considerable distance on both sides of the joint in the bones forming the articulation is not favorable for the reproduction of a movable joint. Such a condition is usually caused by a virulent osteomyelitis the result thereof being a low grade bone tissue which bears the same relation to normal bone that fibrous scar tissue bears to normal soft tissue. Healthy spongy bone should form the articular surfaces of the new joint. Osteoporosis or bone atrophy from disuse should disappear and the structure should return to normal when the position of the limb will permit functional use. As a result of functional adaptation of the osseous structure after many years of complete loss of motion a medullary or central canal may be formed completely traversing the joint from above downward and surrounded by cortex which is developed by the transformation of cancellous bone into dense bone. In such case sufficient base may not be obtained to form a satisfactory joint and further the restoration of function to the atrophic muscles would be difficult.

8 Extensive scar tissue with adhesion of the skin to the bone renders the procedure unsuitable unless preceded by plastic measures to invest the joint completely with soft freely movable tissue. Attempts to close such defects at the time of arthroplasty invariably meet with failure because of the relighting of the infection or sloughing of tissue.

9 The most favorable age is from adolescence to 40 years although it is not so much a question of years as of the character of the tissues of each patient. Arthroplasty is contra-indicated in children as the epiphyses may be traumatized by operation and further it is impossible to secure proper co-operation in the after treatment.

10 In large obese individuals especially women the musculature and ligamentous structure are always deficient. The ligaments should be conserved and great care should be taken to remove as little bone as possible in making the joint space as loose flail joints are likely to occur.

11 In the selection of cases for arthroplasty the social and financial status of the individual must be taken into consideration. The procedure may be employed in all young adults whose occupation is not hazardous or in those who can be rehabilitated.

## TECHNIQUE IN PANKYLOSIS IN FLEXION

When ankylosis occurs in less than 60 degree flexion the anterior structures are redundant and the quadriceps tendon can always be retracted to the outer side. After removal of sufficient bone if the posterior capsule is contracted and extension cannot be obtained stripping of the periosteum from the posterior surface of the femur above and the posterior surface of the tibia below for 1 or 2 inches will usually overcome the contracture and permit the knee to be completely extended after which the procedure is concluded.

Correction of rotation and valgus or subluxation can easily be made in remodeling the joint.

When ankylosis occurs in flexion of over 50 degrees it is advisable to do a two stage operation as follows by a posterolateral incision the posterior portions of the condyles of the femur are excised thus removing about 1 inch of bone at the point of osseous contact to permit greater extension or reduce subluxation if present. Further extension if necessary may be secured by severance of the hamstring tendons. A cast or fixation apparatus is applied with the limb extended as fully as possible but without the slightest tension.

If the necessary degree of correction cannot be attained at the first attempt the cast is removed at the end of 4 weeks and gradual correction of the flexion deformity is made by means of a special apparatus otherwise the cast is worn for 6 weeks. A brace is then applied and walking permitted for about 2 months before proceeding with arthroplasty.

## TECHNIQUE IN FUSION OF PATELLA AND FEMUR

In fusion between the patella and femur with an apparently normal tibiofemoral articulation the skin incision is made as already described the quadriceps tendon is dissected free posteriorly and the union of the patella and femur is severed by a chisel. The interior of the joint is carefully inspected and division is made of any strong fibrous adhesions that may be present. A broad sheet of fascia lata is dissected from the outer aspect of the same thigh and folded inward beneath the quadriceps tendon and the raw surface of the patella the deep surface of this fold facing the patella and quadriceps. Should extensive scar tissue be present in the affected limb a free fascial transplant is taken from the opposite thigh.

## TECHNIQUE IN TIBIOFEMORAL FUSION WITH A FREELY MOVABLE PATELLA

Tibiofemoral fusion rarely occurs with a freely movable patella. This condition may be a sequela of acute infectious arthritis but is more often the

result of a virulent osteomyelitis extending for a considerable distance into the shafts of the tibia and femur with direct bone infection across the joint space. The anterior portion of the joint may have been walled off by inflammatory exudate and protected from the process similar to the phenomenon so frequently seen in the abdominal cavity. If the osteomyelitis has been extensive the indication for arthroplasty is most questionable.

Should arthroplasty be deemed advisable the patellar tendon is retracted to the outer aspect or if contracted is lengthened by the Z plastic method. The new joint is then remodeled according to the method already described although the pedicle flap to the patella is omitted.

This procedure for arthroplasty of the knee is advantageous because (1) stability is better insured by the broad space of contact between the one condyle of the femur and the one tuberosity of the tibia as well as by the conservation of the quadriceps tendon and lateral ligamentous structures (2) loss in length is not appreciable as the greater amount of bone is removed from the posterior portions of the condyles rather than from the longitudinal dimensions and (3) the technique is simple and the contour of the bony surfaces is easily remodeled.

Since the last report the approach to the joint has been radically modified. Formerly the inverted U incision with an additional longitudinal incision passing upward at right angles from the center of the U was employed. This has now been entirely discarded as it has been found that the incision which has already been described is quite ample for exposure of the joint moreover when one incision is made at right angle to another a formation of adhesions and sloughing may occur at the point where the incisions meet. It is also found that the longitudinal incision usually heals better than an extensive transverse incision in an extremity. This is probably due to interference of the blood supply to the part as an extensive transverse incision severs more blood vessels.

For the past 4 years we have routinely employed transplants of free fascia lata as we have found this the most satisfactory material for interposition. In some of our early cases we applied pedicle flaps and prepared animal membranes but we have almost entirely abandoned their use. Prepared animal membranes possess the disadvantage of foreign body irritation invite infection and may be extruded. Fascial lata transplants from animals as described by Koontz<sup>1</sup> have

tures are dissected ul peristally fr m their attachment t the tibia and femur. It is carefully contracted the quadriceps tendon may be lengthened by the Z plastic method. Thereafter it shall be retracted outward. The tibiofemoral union is completely severed until this is accomplished. No attempt is made to flex forcibly even in fibrucases as fracture of the lower extremity of the femur are easily sustained and may constitute a serious complication. The knee is then fully flexed giving free access to the raw bony surface of the tibia and femur. The posterior portions of the condyles of the femur are removed and the intercondylar notch is thoroughly liberated. The lower extremity of the femur may be covered from above downward in fibrin of fibrin. Only the absolutely essential amount is removed from the length of the femur the larger portion of bone being taken from the posterior surface of the condyles. In this way more space will be formed and the length of the limb will be affected very slightly if at all. The upper extremity of the tibia is secured by a little ligament in order to reach healthy joint. With a wood carver's chisel this surface is made slightly concave from before backward forming a large shallow cavity for articulation with the condyle of the femur. After excision of the bone there must be at least an inch and a half between manual traction of the tibia. If this cannot be accomplished more space can often be obtained by dissecting the posterior joint directly from the femur and tibia. No attempt is made to replace the pine of the tibia or the intercondylar notch of the femur for there will be crucial ligaments to prevent lateral displacement. If the articular surface is irregular with lateral displacement may easily occur bringing in the regular surfaces together with of no mechanical damage when motion is instituted. The lateral ligament of the joint must be conserved in order to avoid instability and care must be taken not to tear the other ligaments during operation.

The raw surface are next approximated and the alignment of the entire extremity is tested. If varus or valgus is present more bone is removed from the surface until perfectly straight hinge is formed. Pegs are placed in the position of the normal limb. Pins are should be taken not to produce valgus. Future weight bearing must be direct and in a straight line.

Our attention is next directed to the patella of which the posterior surface is removed to a very thin layer. It is then enough to be consistent with tensile strength. The lateral margins are trimmed

for 4 inch to allow the tendinous fibers to fold back and along the edge of the posterior surface. All surfaces are smoothed with a large rasp. The edges are carefully searched and every particle is to be removed. Just below the patella and on the posterior aspect of the patellar tendon will be found a mass of fat and at times remains of synovial membrane. This is severed at the junction with the tibia and dissected from below upward into a flap with a broad pedicle which is stitched to the margin of the tendinous fiber thus invaginates the posterior surface of the patella. This is an important step for in those cases in which ankylosis recurs adhesion begins between the patella and femur and is the most difficult problem in the restoration of mobility.

The contour of the new joint has now been completed and prepared for interposition of the membrane. As the former infection may have produced fibrosis in the soft tissues about the operative area of the affected limb and in order to avoid excessive surgery to the one member the transplant is best obtained from the opposite thigh.

A long incision is made on the outer aspect of the thigh and a strip of fascia lata about 4 or 5 inches in width and 8 or 10 inches in length is removed. The superficial surface of the membrane is placed next to the bone its fibers are loosely woven and more readily induce the reestablishment of circulation. To facilitate motion the smooth gliding surface is placed within the joint forming the interior of the articulation. This membrane is placed over the lower 4 or 5 inches of the anterior aspect of the femur covering the posterior wall of the superior compartment of the joint. It then passes from before backward over the newly formed condyle of the femur and is stitched posteriorly to the posterior

apex of the joint as high as possible thence it is brought forward over the new articular surface to the tuberosity of the tibia terminating on the anterior aspect of the tibia. All free edges are stitched with cotton chromic catgut all over the margin of the joint. Thus not only is there interposition of layers of fascia lata between the joint surfaces but the layers are interposed between the quadriceps tendon and the tissues on the anterior surface of the femur. The pedicle flap which has already been described interposes an additional layer between the patella and femur. The joint capsule fascia and skin are sutured in the routine manner chromic catgut being used for the deep structure and lermal suture for the skin. Moderate traction is applied and the limb is placed in a Thomas splint.

## TECHNIQUE IN PANANKYLOSIS IN UNION

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# TECHNIQUE IN TIBIOFEMORAL FUSION WITH A FREELY MOVABLE PATELLA

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Since the last report the approach to the joint has been radically modified. Formerly the inverted  $\mathcal{L}$  incision with an additional longitudinal incision passing upward at right angles from the center of the  $\mathcal{L}$  was employed. This has now been entirely discarded as it has been found that the incision which has already been described is quite ample for exposure of the joint moreover when one incision is made at right angle to another a formation of adhesions and sloughing may occur at the point where the incisions meet. It is also found that the longitudinal incision usually heals better than an extensive transverse incision in an extremity. This is probably due to interference of the blood supply to the part as an extensive transverse incision severs more blood vessels

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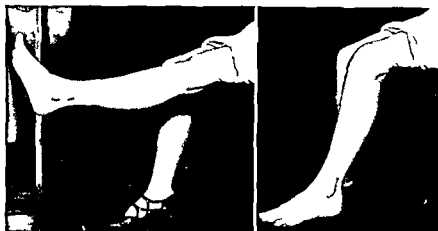


Fig 8 (left) In the position of the leg after the operation. Fig 8 (right) In the position of the leg after the operation. The patient is able to move the leg in the position of the leg after the operation.

been employed in one arthroplasty. This tissue is very well borne and gives apparently satisfactory results although sufficient time has not elapsed to determine its actual value.

In a previous report the author described hemiarthroplasty which was employed where only a portion of the joint was fused as between one condyle and the opposing tuberosity. In such cases we have since found it more expedient to do a complete arthroplasty consequently hemiarthroplasty has been entirely discarded in surgery of the knee.

There have been no serious operative complications or fatalities. Even a severe infection requiring thorough Dakinization does not necessarily prevent an excellent result. However ankylosis may recur even if the most careful after treatment is carried out. In this series of cases even those which have been classified as failures have been benefited by improved function of the limb and correction of the deformity.

#### AFTER TREATMENT

Immediately after operation moderate traction is applied and the limb is placed in a hinged Thomas knee splint and locked in the extended position; no motion is permitted until the operative wound has entirely healed. This usually requires about 10 days. At the end of that time a rope is attached to the center of the hoop of steel and above to an overhead frame. A second rope is fastened to the lower extremity of the Thomas splint passing through a series of pulleys to the head of the bed. By the adjustment of these two ropes any desired angle may be main-

tained and by gravity of the leg under direct control of the patient active and passive motion may be instituted. The patient soon finds that considerable motion is possible without pain. The after treatment does not require exceptional fortitude on the part of the patient if function is cultivated gradually.

Great care should be taken to increase motion early though not too fast. At the end of 30 days there should be not over 30 degrees of passive motion in the knee and at the end of 60 days not more than 40 degrees. If motion is increased too rapidly the atrophic ligaments may become over stretched. Furthermore if osteoporosis—a frequent complication—occurs the osteoporotic bone will be compressed thus increasing the joint space and causing irregularity as well as adding to the danger of producing a loose flail joint. Active motion should be increased synchronously with passive motion and muscle function should be cultivated gradually until restored to an adequate degree.

Complete extension is essential. Flexion of 60 to 80 degrees gives the best function and a member which can be used for all practical purposes.

If the joint is stable at the end of 6 weeks the splint is removed and walking is permitted with a Thomas caliper brace with an adjustable joint at the knee for gradual increase of motion. If there is the slightest osteoporosis a portion of the weight should be borne by a Thomas ring. Full weight bearing should not be allowed until the structure of the bone is practically normal. Disastrous results may occur as late as 9 months after operation because of flattening of the articular

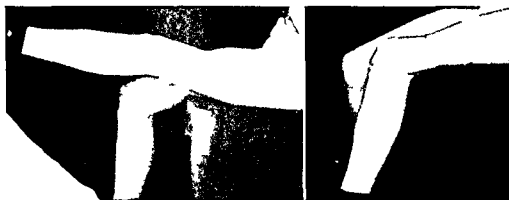


Fig. 9. 1 (left) End results shown 7 years after arthroplasty for ankylosis between the patella and the femur and reconstruction of the quadriceps from the vastus muscles.

Fig. 9. 2 Same case as shown in Figure 9. 1. The knee is flexed while the patient is seated.

surfaces. Weight bearing without support is not advisable until a fair degree of power has been developed in the quadriceps muscle. Extreme care must be given to the reeducation of the extensor groups of muscles; the flexors must also receive due attention. When the patient begins to walk, the knee should be diligently exercised until the maximum power has been restored.

*Brisement forcé* is unnecessary, and in our opinion has little if any place in the after treatment, however, if employed in resistant cases, not more than 10 degrees of increased motion is induced while the patient is under anesthesia, as otherwise a severe reaction may impede the progress of the treatment.

Very often after 6 weeks or months the joint will be quite tender and irritated and ankylosis will appear to be on the verge of recurrence regardless of all treatment. In such cases rest for several days followed by cautiously increased exercise will usually produce marked improvement. Many cases discharged from the hospital as apparent failures were observed months later and found to have a very excellent result with satisfactory range of motion.

There has been much speculation as to the physiology and histology of an ankylosed knee. Recently the author had occasion to incise a successful arthroplasty of the knee 1 year after operation. The findings were as follows:

An internal lateral incision was made in the left knee through the former operative scar. The skin and superficial fascia were found to be normal. The capsule and per articular structures were much increased in thickness, possibly to about 1 inch. Below the capsule a definite joint space about one half the capacity of the normal knee was reached, which extended between the articular surfaces of the tibia and femur and well under the patella and quadriceps tendon. A few adhesions were found between the quadriceps tendon and the posterior wall of the

cavity, but these did not interfere in any way with movement. A very small amount of joint fluid was observed, this was less than is found in the normal joint, but was sufficient for lubrication. The articular surfaces were smooth, glistening and regular and covered with a dense layer of fibrous tissue resembling, in every detail, the free transplant of fascia lata which was interposed at the original operation. There was 90 degrees forcible voluntary flexion and full extension.

A section was removed from the lateral aspect of the joint through this fascia, beneath which was found a cartilaginous layer covering the bone. A small portion of bone with the cartilaginous and superficial fibrous layer was excised for microscopic analysis and will be reported at a later date.

The present report is based upon the analysis of 111 arthroplasties of the knee in 101 patients, of whom 98 were white and 3 colored. One case had 3 arthroplasties on one knee, had operations on one knee and 6 had arthroplasties on both knees.

In 1921 a complete analysis of the first 24 cases was made by the author in an article entitled "Arthroplasty of the Knee."

The foci of infection were not so carefully sought in the cases first reported as in those subsequently treated. Only an approximate conclusion can be reached as to the origin of infection, even in the later cases, since most patients were first examined long after all acute symptoms had subsided. As many of the patients did not know the source of infection and others were reticent as to their history, it is not unreasonable to assume that in a large percentage the pathological process was probably gonorrheal in origin. It is the author's opinion that gonorrhea is the most frequent cause of a monarticular arthritis, despite the records of this series and the fact that the knee is more often involved than any other joint. In 57 patients operated upon since the





One of the successful cases had slight lateral instability and requires a brace. In this type the two stage operation as described is now being employed.

In multiple ankylosis from pyogenic infection the prognosis is not so favorable because the reestablishment of function is obviously more difficult when other joints are ankylosed. Of this class there were 7 cases of ankylosis of the knee 2 of which were bilateral totaling 9 arthroplasties.

Results	Cases
Success	4
Fair (30 degrees with val u )	1
Failure	
Unknown	
Total	5

As yet there is only 1 case of bilateral ankylosis of the knees in which function has been restored in both knees. One knee has 40 degrees of motion the other 30 degrees. Sufficient time has not elapsed to state the permanency of the result or degree of motion which may be acquired. In 2 of the cases no other joint in the lower extremity was involved and there was no difficulty in instituting function. In 1 case with ankylosis of the knee and hip on one side an excellent result was obtained in both joints. This group belongs to a special class and should form the basis of a separate report.

In 6 cases operated upon there had been an extensive osteomyelitis passing through the joint leaving dense scar bone.

Results	Cases
Success	None
Failure	6
Total	6

In all of these infection of a virulent nature was relighted and mobilization of the joint failed although function of the limb was improved by correction of malposition. From these results therefore it is evident that arthroplasty is contra indicated when ankylosis has been caused by osteomyelitis.

Those cases of ankylosis resulting from a low grade progressive arthritis involving many joints also deserve separate consideration. In the series there were 6 cases and 10 arthroplasties belonging to this type.

Results	Cases
Success	1
Improved	2
Failure	7
Total	10



FIGURE 1 (left) End result 8 1/2 years after arthroplasty. Complete active extension of the knee is possible. FIGURE 2 (right) Same case as that in FIGURE 1 showing the range of flexion when the patient is seated.

In the improved cases the patients had fair motion but no voluntary control. One had a flail joint. However both patients were well pleased as they were enabled to walk on crutches and sit more comfortably. In this condition arthroplasty must still be considered to be in the experimental stage. There have been some fair results in other joints which makes the procedure worthy of further investigation. Of course no case is operated upon until all other measures such as removal of foci of infection have been completely exhausted.

Arthroplasty of the knee was performed on 4 children.

Results	Cases
Success	1
Failure	3
Total	4

Forty degrees of motion was restored in the successful case but valgus developed after operation and osteotomy is indicated. This patient the eldest of the 4 was 14 years of age. From this small number and the results secured in joints other than the knee the conclusion has been reached that in children arthroplasty is contra indicated not only for the knee but for all joints.

Of the 111 arthroplasties infection was relighted or instigated in 19 cases. In 6 of these cases there had been an extensive osteomyelitis. In 4 cases the infection was apparently due to irritation of the chromicized pig bladder which had been interposed between the joint surfaces. In 4 cases the results were excellent although complicated by a virulent infection. In these Drakin tubes were inserted in every direction and irrigation was continued for weeks.

At the present time there are 43 cases under observation in which function of the knee varying from 35 to 120 degrees has been restored. Only 4 cases have as little as 35 degrees of mo-

tion and this may increase in time The average is 90 degrees The most efficient and durable joint has not over 80 or 90 degrees of flexion which is sufficient to permit walking without limp and sitting in comfort

An estimate of the results of arthroplasty of the knee should be expressed in the terms of function and endurance and not in degrees of motion As more experience has been gained by observing the complications and important factors in the evolution of the procedure the operative technique and after treatment have been refined and the scope of the procedure has been materially increased

A full report of the entire 43 cases in which function has been successfully restored would be impractical however there are 6 cases of special interest which will be described briefly

C 3 B W m le g y rs of age had nkylo of th l ft k with mplet o e s f bet e th p t l d f m d t t l l f th qu d c p s t d Th t b f m l t t u l a t n n m l Th et l g y w mpo d f t u f the f m ith ru l t f t f th bo d f t t Th t th pl ty d ut so to f m t ut t b l ty th p tell d f mu In d d t w q d n p te d n co t r u c t e d f m th t m u s c l Th l t w x l l t l th gh th qu d c p s f se k th m l S u f f i t m l p o e w t d t b l th pat t t d th k e e f l l y d t walk th t p e p t b l m p

t d a d at th nd f 6 m ths the e w s 90 deg e m to with o ly l g h t l ty th es l t w s c n d r e d c l l n t At th d f o m o ths th p t e t r e t n e d h o g d f i t l ty d t s a l g s d f r m ty Th \ y t th t m e d m t t e d t d e t r u c t e c h a g e th k w t h l of b s t a c e n the e x t e n a l c o d y l f t h f m u d u e t o t p o s

This case illustrates the necessity of careful observation over a long period of time It is mentioned in order to demonstrate a late and unusual complication which might have been avoided if such a possibility had been known prior to that time The cause of this complication was the too rapid increase in motion which was not commensurate with the muscle power

C 4 M H K f m l g y r f g had k y l f th r g h t k f o l l n g p y o g e s f e c t Th r t h p l t d o a t t e l s the f r t w f l d th th r d w r y s f l F t l p t 6 y a the j o t h s b e e t b l e w t h n o r m l d l t h g h t h \ y s h o t s i e p l f t b u t t h m g f t h j o t d the p i l l f d t the t r p t o f t h u p p f c f t h t b f t th m n f the l c n p r the l b C s 5 I P f m l y s f g h d a p y o g e f t f the l f t k w h h a u d m p l e t e k y l A n t h r p l t y w p f r m d d r o r y t f l Th r y r l t t h p t t s t a d m m t e d f a t f t h l i t f e m u n t h e k e j o t A f t 5 y r s t h \ y h o w t e e p o l f t e h g t h k a d t h p t l l f u d t h n t o p t f t h t b Th p t t h s d b l j t a d n C e 6 E K f m l 4 y e r s f g e h d p l y t l p y n f t o l t g s o l d b o n y k y l f t h g h t h p d k t h m l f m a t f b o t h j t A t h p l t y d o t t e c h j n t d t h r l t l l t

This case is of special interest on account of the fact that a functional quadriceps was restored after complete destruction

This case is most interesting on account of the unusual course the sinuses which persisted over a long period of time and the excellent result

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This case is interesting and unusual in that function has been restored to the hip and knee of the same limb

## A STUDY OF ARTIRIAL OCCLUSION BY MEANS OF AUTOGENOUS FASCIAL STRIPS

BY P. W. McNEALY, M.D., FACS, AND M. I. ICHTENSTIHN, M.D., CHICAGO  
 Fifth Department of Experimental Surgery

RECENT studies dealing with the surgical occlusion of blood vessels have been conducted along two principle lines. In the first instance there has been a rather considerable amount of work done in developing special clamps or devices for the purpose of producing gradual occlusion of the vessel lumen. In the second instance attention has been directed to the resection of the vessel and surrounding tissues to the use of such ligature materials as silk, linen, catgut and especially fascia.

The study of methods of gradual occlusion has had as its incentive the necessity of gradually diminishing the flow of blood through a diseased or injured vessel in order to stimulate the formation of a collateral circulation while still maintaining a supply sufficient to prevent immediate tissue death.

The present study is concerned with a method of gradual occlusion of a blood vessel by transplants of fascia placed about the vessel and anchored in such a way that continuous traction is made in a constricting manner. The use of fascia in vascular occlusion is admittedly in no wise a new procedure; nevertheless we feel that our results obtained in experimental animals warrant the report of the method which we have used.

The various methods of gradual vascular occlusion may be briefly summarized as follows: snares of silk, metal or catgut have been placed about vessels so that they can be tightened at intervals. These devices were in most instances unsuccessful because infection traveled along the protruding snare and caused either thrombosis or secondary hemorrhage from vessel erosion. In other experiments bands of silver or aluminum were so constructed that they automatically tightened about the vessel or could be tightened by exposing them at subsequent operations. The bulk of these devices and their tendency to irritate the tissues and corrode the vessels rendered their use somewhat hazardous.

In 1917 W. S. Halsted (3) reported his experimental use of strips of aorta, fascia lata and intestinal wall. The following quotations which have been taken from his original report adequately summarize the results of his series of experiments:

In April 1912 I operated upon two dogs partially occluding the aorta of one of them with a spiral aortic band and the other with a cuff cut from the same vessel. Strips of aorta were employed rather than fascia for example because I hope that the elastic tissue in case it did not endure might at least serve its purpose for a time sufficient to cure an aneurism.

At the end of two months one of the dogs was killed and I was pleased to find that the cuff which had been used in this experiment was apparently organized and had not stretched to any appreciable extent. Above the cuff the aortic pulse was forceful but below the constriction it was very feeble though countable and accompanied by a thrill. The other dog operated upon at the same time and in the same manner except that a spiral band of aorta instead of a cuff had been employed died about three weeks after operation (Death due to pneumonia). In this instance the aorta had been completely occluded by the spiral aortic strip. The welt like band had not stretched and seemed to be organized. The aorta in being split longitudinally was seen to be greatly wrinkled and almost occluded at the site of the band.

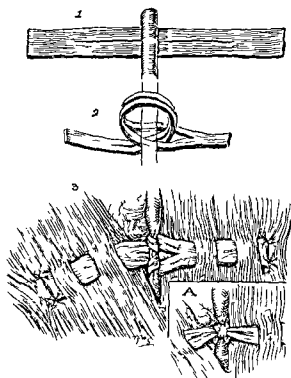
Since then about 25 similar operations have been performed. We have learned however that whereas the spiral bands seem to be perfectly safe there is danger in employing the cuffs. In two instances of twelve or more experiments one of the mattress sutures taken to hold the flaps of the cuffs together cut part way through the cuffs and thus being in contact with the aortic wall wore a minute hole through the vessel through which the animal bled to death. Such an accident can hardly happen with the employment of the spiral strip for not only is the strain on the stitches very slight when this form of band is used but even if it were so great that a thread might cut through the spiral at any one point it could hardly be brought to bear on the aorta in such a way as to wear into its wall.

Since Halsted's report of his experiments there have appeared from time to time reports of isolated instances of the use of fascial cuffs for occluding vessels when it was desirable to use proximal ligation in the cure of a peripheral aneurism.

Brooks (1) in reporting the use of fascial bands for vessel occlusion concluded that the ligatures cut through and the bands loosen. For this reason he found objection to their use.

Campbell (2) recently reported 3 cases of peripheral aneurism in which fascial cuffs for proximal ligation were used with apparent success. Little is mentioned in these reports save the clinical features of the cases.

Reid (5) describes a method of occlusion with fascial plugs which are placed upon the blood vessel and held in place by a constricting ligature. Thus no trauma occurs to the intima as the lumen is obliterated by the flattening of the vessel.



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In our work little opportunity is offered for the fascial to loosen and there is no likelihood that the sutures will come in such contact with the vessel wall that erosion might result.

#### TECHNIQUE

Our method consists in the dissecting of strips of fascia 5 centimeters long and 1 centimeter wide from any available fascial plane. In our experiments on dogs these strips were taken from the anterior layer of the rectus sheath. This fascial strip is further prepared by its being freed of fat and then slit longitudinally to within about 1 centimeter of each end (Fig. 1). This strip is then placed under the vessel and one end threaded through the slit of the opposite end thus forming a figure 8 at the vessel. Traction on the end not only constricts the vessel but also to regulate slightly. The next step consists in the use of a small pair of artery forceps through adjacent muscle in an interrupted manner and the grasping of the end of the fascia to draw it through the muscle fiber. The tension may now be secured by the fixing of one end of the fascia and

gentle traction on the other until the peripheral pulse is diminished as much as desired. This tension may now be preserved by sutures passed through the end of the strip of fascia into the muscle belly.

#### RESULTS OF INVESTIGATIONS

After interval varying from 2 weeks to 4 months the condition of the constricted vessels and the fascial transplants was investigated.

The changes in the blood vessels were quite constant. In 5 dogs there was complete occlusion of the femoral artery at the site of the fascial strip. It was impossible to separate the vessel from the fascial strip except by sharp dissection. The vessel showed no apparent destruction of its intima which was longitudinally folded upon itself. In each instance the lumen could be dilated with a small probe. In one case the vessel was markedly constricted but a faint pulse could still be felt distal to the fascial strip. When opened the vessel lumen presented much the same appearance as in cases of complete occlusion.

The fascial transplants remained fixed in each instance and there was a firm fibrous union between the connective tissue of the muscle bundles and the fibers of the fascial strips. This characteristic manner of muscle and fascial union which has been described in these experiments bears out the contention of Koontz (4) as to the herding of the structures.

In one of our dogs it was interesting to note that when the fascial strip was first applied and the leg completely relaxed by flexion that the pulse peripheral to the fascial strip could be plainly felt; however when the leg was completely extended the pulse was obliterated.

In order to study the comparative value of this method with that of fascial strips used as simple ligatures we ligated the femoral arteries of 3 dogs with narrow autogenous fascial strips (Fig. 1A). We found that the partial occlusion of the vessel which was established at the time of operation largely disappeared because of the loosening of the fascial strips. We believe that this regular tendency of the strips to loosen may be explained on the basis that there is decidedly less tendency for union of the component parts of a transplant than there is between a transplant and the vascular tissues of adjacent structures as in our method.

#### SUMMARY

1. This method of fascial occlusion of blood vessels is free from many of the faults found in methods now in use.

By regulating the tension on one end of the fascial strip any desired construction of the vessel may be fairly constantly maintained.

3. No suture material can come in contact with the vessel and cause an erosion of its wall.

4. Fascial strips are not irritating to the surrounding tissue.

5. Fascial strips have no tendency to act as foreign body irritants to the vessels themselves.

# REFERENCES

1. BRIDGES, R. Ligation of the aorta. *J. Am. Med. Ass.* 19 (1922) 11.
2. CAMPBELL, J. L. Fracture of the femur in the treatment of aneurism. *South. M. J.* 1921, xiv, 9.
3. HALL, W. S. Occlusion of the aorta with strips of fascia. *Ann. Surg.* 19 (1913) 183.
4. KESTER, A. E. Healing in hernia repair. *Int. Nat. Surg. Soc.* 1927, 1, 4.
5. KENNEDY, M. F. Complete occlusion of the aorta with fascial plugs. *J. Exp. Med.* 19 (1912) 293.

## THE TREATMENT OF FRACTURES OF THE NECK OF THE FEMUR BY DOUBLE Traction CASIS IN HIND TRACTION AND IRON CURVE SUPPORT

By JAMES I. M. THOMSON, M.D., F.A.C.S., LINCOLN, NEBRASKA

WITH the introduction of the so called Whitman position and wide abduction spica cast in the treatment of fracture of the neck of the femur the greatest contribution to the treatment of this condition was added to surgery. It is a positive method of maintaining position and alignment of the fragments provided adequate traction is instituted during the application of the cast through the traction devices of the modern fracture table.

One disadvantage which we encountered in its use was that quite often after several weeks shortening and loss of position were found to have developed in spite of the application of a widely abducted spica cast extending from the tips of the toes to the axilla. In addition there

was considerable discomfort at times in the dorsum of the foot, ankle or knee and especially about the abdomen and chest. This was particularly true of elderly obese patients. Furthermore the pelvis on the injured side was usually so severely tipped that considerable permanent disability often occurred.

It was found however that by immobilizing both the uninjured leg and the fractured member in wide abduction under traction only a low pelvic band of plaster was needed to maintain position so that the upper abdomen and chest could be left free of plaster thus adding considerably to the comfort of the patient. This also permitted equalized traction on both sides of the pelvis and eliminated the tipping of the pelvis.

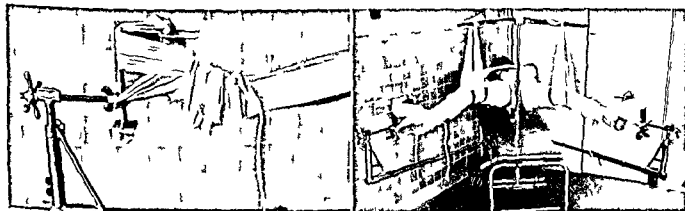


Fig. 1 (left) The foot is bound with muslin bandage to the traction device of the fracture table. Mole skin traction strap with rope end are applied to either side of the leg extending from well up the thigh to the ankle.

Fig. 2 The patient lies on the fracture table with both

legs widely abducted. The feet are bound to the traction foot pieces of the table. The rope ends of the traction straps are hanging free. Muslin bandage and sheet wadded are placed over the strap. The knees are slightly flexed by means of overhead slings.



Fig. 3 (left) Applied to the femur the principle of fixed traction the technique of which Dr H W Orr and I have recently published. The application of this principle to fractures of the neck of the femur is briefly reviewed as follows.

By fixed traction is meant traction which once applied is so secured by means of the plaster of Paris cast that it remains intact during the period that the cast is worn. Its application in this particular instance requires that the patient be placed on a fracture table that both legs be placed in the extension apparatus by binding the feet firmly to the foot pieces of the table and be abducted to the degree necessary to bring about apposition of the parts. Traction is then applied equally to the uninjured as well as the injured leg thereby bringing the pelvis down in correct position against the pelvic rest of the table. When full length and proper position are attained long moleskin traction straps which have rope ends and extend well up on the thighs are applied to

Fig. 4 (right) The method of applying the plaster of Paris cast to the leg. The knee is flexed slightly by means of overhead retaining slings and a plaster of Paris double spica cast is applied from the lower pelvis down to the ankle. After the plaster has set the rope ends of the traction straps are turned back against the side of the leg casts. While forceful pull is made on the ropes plaster of Paris sufficient to imbed them in the cast is applied. The traction is kept up during the procedure through the foot pieces to which the feet are bound. Therefore when the bandages are cut from the foot the fixed traction straps will not permit the leg to slip back up into the cast.

Two boards, one below the knees and behind the calves of the legs and the other above the knees and over the quadriceps region are imbedded in the plaster cast. Sheet wadding is applied to the feet and they are put up in plaster in the right an leg position if one is not certain that

either side of both leg and held in position by muslin and sheet wadding, bandages. The knees are flexed slightly by means of overhead retaining slings and a plaster of Paris double spica cast is applied from the lower pelvis down to the ankle. After the plaster has set the rope ends of the traction straps are turned back against the side of the leg casts. While forceful pull is made on the ropes plaster of Paris sufficient to imbed them in the cast is applied. The traction is kept up during the procedure through the foot pieces to which the feet are bound. Therefore when the bandages are cut from the foot the fixed traction straps will not permit the leg to slip back up into the cast.

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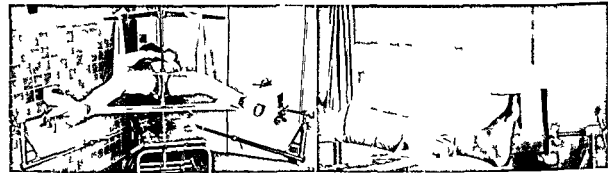


Fig. 5 (left) The method of applying the plaster of Paris cast to the leg. The knee is flexed slightly by means of overhead retaining slings and a plaster of Paris double spica cast is applied from the lower pelvis down to the ankle. After the plaster has set the rope ends of the traction straps are turned back against the side of the leg casts. While forceful pull is made on the ropes plaster of Paris sufficient to imbed them in the cast is applied. The traction is kept up during the procedure through the foot pieces to which the feet are bound. Therefore when the bandages are cut from the foot the fixed traction straps will not permit the leg to slip back up into the cast.

Fig. 6 (right) The method of applying the plaster of Paris cast to the leg. The knee is flexed slightly by means of overhead retaining slings and a plaster of Paris double spica cast is applied from the lower pelvis down to the ankle. After the plaster has set the rope ends of the traction straps are turned back against the side of the leg casts. While forceful pull is made on the ropes plaster of Paris sufficient to imbed them in the cast is applied. The traction is kept up during the procedure through the foot pieces to which the feet are bound. Therefore when the bandages are cut from the foot the fixed traction straps will not permit the leg to slip back up into the cast.



Fig 7 (left) Showing the complete cast with cross bars in place

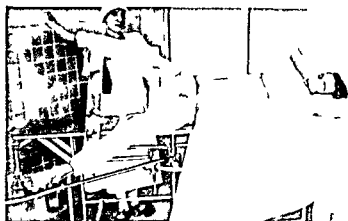


Fig 8 Tipping the casts also tips the pelvis. The

triangle truss supports applied by the cross bars insures the relative movement of all the component parts when one part is moved

proper exercise will be given to the feet to prevent their falling into an equinus deformity. However if the patient can afford adequate nursing care he derives great satisfaction from having his feet left out of the cast. Daily massage can be given and the patient can be encouraged in the use of the muscles of the leg and foot.

When the patient is moved to a bed the springs should be stiffened by cross boards under the mattress the foot of the bed should be elevated 8 or 10 inches and just sufficient weight should be tied to the lower cross board and placed over the end of the bed to accommodate the pull of the body against the cast. The amount varies of course with the weight of the patient. In this position the patient can be turned on his face daily or propped up a little.

Even with this short cast about the pelvis many elderly patients with pendulous abdomens have objected strenuously to the restraint of the

plaster about this region and have said that if they could only be propped up some of the time in bed and not have a tight band across their bowels they would be happier. Therefore after a week or so the anterior or abdominal portion of the pelvic part of the cast was removed letting the posterior part hold the legs in position. The patient was propped up with pillows or back rest care being taken that strenuous traction on the cross bars of the cast was kept up and the foot of the bed kept elevated. Roentgenograms have shown that no ill effects result from this modification of treatment.

The success of this procedure led to the adoption in practically every case of the following technique. Two leg casts are applied in a widely abducted position both legs having fixed traction applied by the use of moleskin traction straps imbedded in the cast. One cross bar is placed above and one below the knees thereby equalizing the pull of one leg against the other and that of both legs against the bony pelvis.

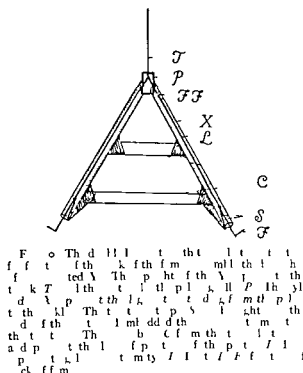
The essential points in the application of the leg casts are exactly similar to those described in regard to the double spica. Considerable care should be taken to make sure that the leg casts come well up against the pubes and high up about the trochanteric prominences. The casts must fit well. There should be ample padding in the region of the pubes the trochanters and the knees. For this purpose a light weight felt is preferable but care should be taken that the padding is not too heavy.

The writer has endeavored to illustrate the principles involved by a series of lines forming an inverted Y (Fig 10). The angle at the junction of the Y represents the pelvic girdle the upright line the trunk of the body. The two forks represent the lower extremities. A break appears in



Fig 9 This patient had been in casts for 8 weeks. From the time the casts were applied she had been able to sit propped up with back rests as often as she wished. During her stay at the hospital she did a considerable amount of reading and writing. The foot of the bed is elevated. Traction is applied to the lower cross bar over the foot of the bed.





one of these lines just below the pelvic angle. Along the course of these line a cord is attached and about them two cylinders are placed the upper end of each in contact with the pelvic angle the lower coming well down to the ankle region. Separating the cylinders are two cross bars welded into the cylinders one up near the pelvic girdle and the other down toward the ankle. The traction cord are attached to the extremity line and are brought down over the lower end of the cylinder and turned back tightly against it and then tied to the lower cross bars. At the junction of each one of these cross bars with the cylinder a rigid triangle truss is formed. The cord attached to the extremity line and to the low cross bar hold the cylinder up in position against the pelvic angle and stabilize the extremity within the cylinder so that every turn which the body makes involves a rotary movement of every other part of the frame work from the pelvic girdle down so that it is impossible to change the position of the broken extremity. Thus one extremity is splinted against the other and the traction on each is firmly fixed.

Here the engineering structural principle of a series of triangle truss is applied through the cross bars and pelvis. The traction straps in addition to holding the traction stabilize the lower extremity in the casts. Such procedure when applied to the human body has a greater stabilization than shown in the

tion in that about the fractured neck of the femur are the heavy muscles of the hip joint which aid greatly in the stabilizing of the fragments.

In addition to this procedure for the past year or so we have uniformly impacted with gratifying results every fracture of the neck after the method described by Dr. Fred J. Cotton. More recently the writer has used a concave block fitted over the trochanteric prominence against which the flows of the mallet may be more accurately aimed. The impaction adds much to the security of these cases and seems to help bring about their successful termination. Elderly fleshy patients tolerate this method of fixation better than any other as it enables them to have far more freedom than can be allowed if the trunk is covered with a cast or than can be had by Buck's extension Thomas splints or other traction apparatus. The method involves the use of a traction table which is now a part of the operating room equipment of every first class hospital.

At first I used this method rather dubiously but constant checking by X-ray examination demonstrated the reliability of the procedure so that now I allow these patients almost unlimited freedom in bed provided traction is kept up on the lower cross bar over the end of the bed to take care of any unusual jerks or sudden change in position that may occur during the first week or so of treatment. Very often in spite of strict orders I have found patients sitting bolt upright with out even a back rest shaving or combing their hair or lying on one side half way out of bed. I have often suspected a loss of position but X-ray examination has always shown the fragments to be in correct alignment.

After 8 or 10 weeks the casts are removed and a long well fitting ring caliper splint is applied. This is worn for a month. The patient is allowed to use a wheel chair. During this time massage and active and passive motion are encouraged daily. At the end of 12 weeks the patient is allowed to walk with crutches. The weight on the fractured leg is carried through the ring against the ischium. If the X-ray examination is satisfactory after 6 months the patient may walk with a cane and crutch until at the end of 9 months to a year all apparatus and support may be discarded.

A sufficient number of cases have now been treated successfully by triangle truss supported leg casts to justify a preliminary report of the technique. I have found that this method adds much to the comfort and well being of my patients and so far the procedure seems to be thoroughly satisfactory.

## A NEW PROCEDURE IN THE DIAGNOSIS OF URETERAL CALCULI

BY I. M. H. I. DOUKMASHIKIN, M.D., NEW YORK

SINCE the advent of X ray and cystoscopic methods of diagnosis of ureteral stones the correct interpretation of X ray shadows lying in the course of the ureteral tract has presented many difficulties. The extraneous shadows lying side by side with the ureter may frequently exhibit typical signs of a ureteral calculus so as to confuse the most experienced observer. An error is especially possible when the symptoms point to a lesion in the urinary tract on the side on which the shadow was noted.

Twenty six years ago Kolscher and Schmidt (3) suggested the use of a shadowgraph catheter

in order to determine the relationship which may exist between the lumen of the ureter and suspicious shadows. This simple procedure remains up to this date the most reliable method by means of which most of the shadows of extra ureteral origin may be so determined by finding them at some distance from the course of the opaque catheter. A possible error which probably was not pointed out before may be due to the failure



Fig. 1. Extra ureteral shadow, having all the typical marks of a ureteral calculus. The patient was a young man giving a history of severe attacks of renal colic on the same side. The shadow resembled a stone so closely that the patient was advised on the strength of X ray findings to have an operation. The extra ureteral origin of the shadow is of course self evident (double ureter being excluded by cystoscopic examination). However if this shadow had been in closer proximity to the ureter an error in diagnosis might very easily have been made. Note the dilatation of the ureter which is most probably the result of a stricture below.



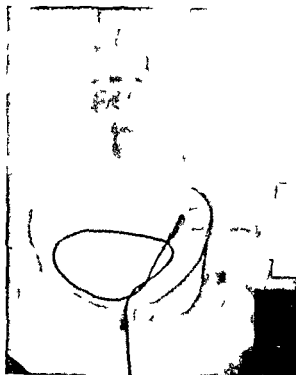
Fig. 2. A pyelo-uretero-ramification. The reason for the failure to elicit scratch marks on wax bulbs passed into ureter containing a stone. The upper arrow indicates the filling defect produced by a small uric acid stone floating freely in the dilated portion of the ureter. On the plain X ray film the position of the filling defect was marked by a faint shadow separated from course of the opaque catheter by 1 centimeter. The lower arrow indicates the filling defect produced by the wax tip of a shadowgraph catheter which was drawn down while the opaque solution was injected. This case demonstrates how a wax bulb may pass by the stone without effecting an actual contact with it.



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on the part of the cystoscopist to recognize the double ureter on the affected side. When a roentgenograph catheter in such a case is passed in the ureter not containing the stone, the finding shadow (produced by a stone in the other ureter) at some distance from the course of the opaque catheter may lead one to an erroneous conclusion. That the condition is not so very rare may be misjudged from the fact that the author found anomalies in a series of 355 cases of stone in the ureter (1). Another error may be due to a floating in the dilated portion of ureter in which case its shadow may be seen to be separated from the course of the opaque catheter (Fig. 2).

The use of the opaque catheter, however, has no diagnostic value when the shadow in question is found in close proximity to the catheter. A similar picture may be produced by an extraluminal shadow incidentally in juxtaposition with the ureter. Ordinarily, in the presence of impaction, we have sufficient cystoscopic evidence pointing to calculous obstruction. In such cases the diagnosis based on cystoscopic findings and corroborated by an X-ray showing the opaque catheter either just below or in close contact with the shadow in question is easy. It is in nonimpacted cases in which the cystoscope very frequently fails to show any evidence of trouble that correct interpretation of X-ray shadows is essential. The use of the wax tip catheters, at least in our experience, has been entirely unreliable in that it



Fig. 6. Case 1. A shadow (arrow) placed in close proximity with an opaque catheter 7 centimeters above the bladder. The patient was a young man whom I saw in September 1926 and who gave a history of repeated attacks of renal colic on the right side. Cystoscopy revealed diminished renal function and moderate amount of retention on the same side. A slight obstruction was encountered at 7 centimeters with a No. 8 Charrière wax tip catheter which was ineffective for a scratch mark. A diagnosis of ureteral calculus was made.

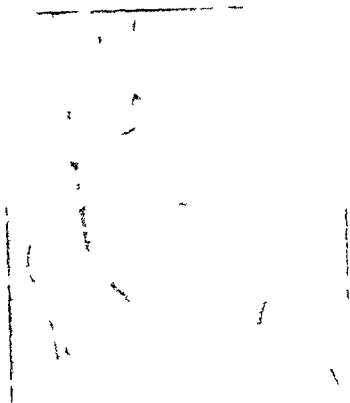


Fig. 7. Case 1. Three months later. The right ureter was gradually dilated until 3 catheter (Nos. 5, 6, and 7 Charrière) could be introduced easily. Note that the shadow (arrow) is still in the same place. The patient no longer complained of attack of renal colic.

frequently fails to elicit scratch marks. It is indeed very surprising how a wax tip catheter may slip by a stone or push its way up and yet escape without the slightest indication of any scratch mark. This may be due in a great measure to the comparative smoothness of movable stones to a film of slimy mucus covering the calculus or to the passing of the wax bulb into a dilated ureter without effecting an actual contact with the stone.

The double exposure from different angles a method used by Kretschmer (4) since 1918 has been of great value in determining the status of suspicious shadows in some cases. It is however not always successful as the questionable shadow may remain in the ureteral line on both exposures (Fig. 11). Furthermore the shadows frequently become so blurred that the correct interpretation of the roentgenogram is impossible. Faint shadows are often not duplicated and are difficult of recognition in pictures taken of stout patients.

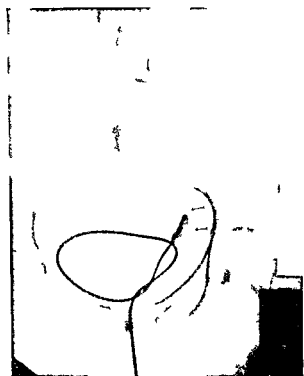
Bransford Lewis (5) in 1922 described an ingenious method whereby true stone shadows

could be differentiated from those cast by phleboliths or calcified glands. By using his rigid dilator he caused the ureter to be straitened out thus separating it from an extraneous shadow which was previously noted to be in close contact with a flexible catheter. This method however entails the passage of a rigid instrument beyond the level of a shadow in question which may not always be done and is of doubtful value higher up where the course of the ureter is fairly straight.

Recently Ziegler (8) suggested the use of a double exposure roentgenogram on an empty and distended bladder. If the shadow is that of a stone it will be doubled because of the elevation of the lower ureteral segments by the distended bladder while the shadows of extra-ureteral origin will remain single. Joseph in his recent visit to the United States showed some interesting films illustrating this method. Such a procedure however is of value only in cases in which the shadow is seen in the region of the juxta-vesical portion of the ureter. Furthermore the



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on the part of the cystoscopist to recognize a double ureter on the affected side. When a shadowgraph catheter in such a case is passed into the ureter not containing the stone, the finding of the shadow (produced by a stone in the other ureter) at some distance from the course of the opaque catheter may lead one to an erroneous conclusion. That the condition is not so very rare may be surmised from the fact that the author found 2 such anomalies in a series of 355 cases of stone in the ureter (1). Another error may be due to a stone floating in the dilated portion of ureter in which case its shadow may be seen to be separated from the course of the opaque catheter (Fig. 2).

The use of the opaque catheter however is of no diagnostic value when the shadow in question is found in close proximity to the catheter as a similar picture may be produced by an extraneous shadow incidentally in juxtaposition with the ureter. Ordinarily in the presence of impaction we have sufficient cystoscopic evidence pointing to calculous obstruction. In such cases the diagnosis based on cystoscopic findings and corroborated by an X-ray showing the opaque catheter either just below or in close contact with the shadow in question is easy. It is in non impacted cases in which the cystoscope very frequently fails to show any evidence of trouble that correct interpretation of X-ray shadows is essential. The use of the wax tip catheters at least in our experience has been entirely unreliable in that it too



Fig. 6 Case 1. A shadow (arrow) placed in close proximity with an opaque catheter 7 centimeters above the bladder. The patient was a young man whom I saw in September 1926 and who gave a history of repeated attacks of renal colic on the right side. Cystoscopy revealed diminished renal function and moderate amount of retention on the same side. A slight obstruction was encountered at 7 centimeters with No. 8 Charrière wax tip catheter which was negative for a scratch mark. A diagnosis of ureteral calculus was made.

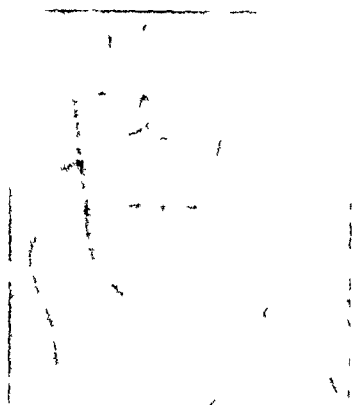


Fig. 7 Case 1. Three months later. The right ureter was gradually dilated until catheter (No. 5, 6 and 7 Charrière) could be introduced easily. Note that the shadow (arrow) is still in the same place. The patient no longer complained of attacks of renal colic.

frequently fails to elicit scratch marks. It is indeed very surprising how a wax tip catheter may slip by a stone or push its way up and yet escape without the slightest indication of any scratch mark. This may be due in a great measure to the comparative smoothness of movable stones to a film of slimy mucus covering the calculus or to the passing of the wax bulb into a dilated ureter without effecting an actual contact with the stone.

The double exposure from different angles a method used by Kretschmer (4) since 1918 has been of great value in determining the status of suspicious shadows in some cases. It is however not always successful as the questionable shadow may remain in the ureteral line on both exposures (Fig. 11). Furthermore the shadows frequently become so blurred that the correct interpretation of the roentgenogram is impossible. Faint shadows are often not duplicated and are difficult of recognition in pictures taken of stout patients.

Bransford Lewis (5) in 1921 described an ingenious method whereby true stone shadows

could be differentiated from those cast by phleboliths or calcified glands. By using his rigid dilator he caused the ureter to be straightened out thus separating it from an extraneous shadow which was previously noted to be in close contact with a flexible catheter. This method however entails the passage of a rigid instrument beyond the level of a shadow in question which may not always be done and is of doubtful value higher up where the course of the ureter is fairly straight.

Recently Ziegler (8) suggested the use of a double exposure roentgenogram on an empty and distended bladder. If the shadow is that of a stone it will be doubled because of the elevation of the lower ureteral segments by the distended bladder while the shadows of extra-ureteral origin will remain single. Joseph in his recent visit to the United States showed some interesting films illustrating this method. Such a procedure however is of value only in cases in which the shadow is seen in the region of the juxta-vesical portion of the ureter. Furthermore the



F. S. C. F. m. th. l. r. l. h. l. ad. )  
 us. t. l. th. pl. N. 4. F. t. l. l. d. b. u. g.  
 it. p. t. b. y. The. th. t. t. h. d. t. th. b.  
 op. q. sa. f. l. l. u. g. h. h. pl. th.  
 w. p. p. t. n. t. f. m. th. h. d. w. q. t.

picture is very often blurred especially in stout patients and in several instances of positive ureteral stone shadow. I have failed to produce its reduplication.

The stereoscopic X-ray examination while of great value in certain types of cases will quote such an authority as I. Seth Hirsch often fail to show the true relationship of X-ray shadows lying along the of the ureteral tract to the lumen of the ureter. The stereoscopic apparatus has not as yet become part and parcel of the urological equipment and in its absence one must resort to other methods of diagnosis.

The injection of opaque solution into the ureter is sometimes of no value because unless the stone shadow is faint or the solution is highly concentrated it produces no contrast between the shadow cast by the calculus and that produced by the opaque solution with the exception of the non-opaque uric acid stones which may be beautifully demonstrated by a filling defect. Stevens (7) was the first to describe this procedure in 1917 and in the author's experience it has proved of immense value in clearing up some doubtful cases.

I. o. C. I. e. m. th. lat. Th. p. t. t.  
 p. t. d. m. p. l. t. d. p. p. c. f. l. l. y. m. p. t. m. b. t. p. l. n.  
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Recently the author has resorted to a new procedure which it is believed offers an accurate solution to the problem. This method depends upon the property of the rubber bag catheter when introduced into the ureter and inflated to expand not only laterally but in a longitudinal direction as well as has been shown by the author experimentally on cadaver and clinically in a large series of cases (2). The type of the rubber bag used is that which is attached to the catheter only at the proximal end (Fig. 14). The bag when introduced to a point even several centimeter below the calculus will continue to expand until the stone is reached (Figs. 3 and 4). If the stone is impacted the longitudinal expansion will stop short (Fig. 3). If the stone is movable it will as a rule be pushed up by the inflated bag sometimes for a distance of 4 or 5 centimeter (Fig. 4). This was demonstrated clinically in numerous instances. In all cases the resulting bago ram will show the stone above the inflated bag unless the bag was distended when placed deliberately along side of the stone in which case



Fig. 10. Case 2. A shadow (arrow) in close contact with opaque catheter in left ureter in a woman giving a history of repeated attacks of left renal colic. Cystopyelogram of left sided hydronephrosis decidedly diminished renal function and low grade colon bacillus infection. There was no obstruction to a No. 9 Charrier ureter catheter which was negative for scratch marks.



Fig. 11. Same as Case 2. A double exposure roentgenogram revealing the shadow in the same relation to the opaque catheter on both exposures. The stone produces an impression that the shadow in position is that of a stone.



Fig. 12. Same as Case 2. A rubber bag was introduced into the left ureter (arrow) and roentgenogram taken before inflation.

definite indentation will be produced on the side of the bag in contact with the calculus (Fig. 5).

A rubber bag introduced below the shadow in question previously noted alongside of an ordinary opaque catheter will produce when inflated with an opaque solution a shadow which will be superimposed upon and cause the complete disappearance of any shadow of extra ureteral origin while that of a true stone will be seen above the bagogram. As far as I know this method permits of no source of error except in those rare cases in which the stone is lodged in a ureteral diverticulum as in the case of McFarland (6). It may be argued on a theoretical basis that a stone in the ureter may be lodged behind or in front of an inflated bag and its shadow be swallowed by that of a rubber bag. Practically this is impossible because in our technique the bag is always introduced to a point below (Fig. 12) the stone and its position verified by X-ray before inflation. When a bag is inflated within the ureter longitudinal expansion takes place only after the ureteral wall is stretched laterally to a point within a certain degree of distensibility. This again has been shown experimentally on human cadavers and ureters of oxen. Before the bag has reached the stone the lumen of the ureter is filled up so completely with the inflated bag that any





Fig. 3. S. m. C. Th. rub. t. g. fl. t. d. th. p. l. l. t. Th. l. w. d. t. th. p. t. f. th. t. p. f. th. thet. th. th. b. g. w. h. t. p. d. l. g. t. d. l. l. f. f. l. l. y. 3. t. m. t. N. t. th. d. p. l. f. th. h. d. w. q. t. th. m. b. l. l. d. by. th. t. f. fl. t. d. b. b. b. g. th. l. w. g. t. t. t. l. H. d. th. b. t. t. h. d. w. t. w. l. d. h. b. n. t. d. b. th. b. b. b. g.

possibility of the dropping of the stone behind in front or on the side of it is excluded. Occasionally a fragment of the extraneous shadow may still be seen along side the bag of ram because of the failure of the ureter to expand sufficiently in a lateral direction to cover it. The extra

Fig. 4. An flat de c ued th wolk h h th b g t d to th c thet at th p mal d ly ll f d t t f th d tal po t I 5 A bb b g th t th a l t p Th b t e d t both d d p m t l t l d t t ly i fo th e l d t b d f d g t p r p se

ureteral nature of such a shadow may of course be readily understood.

To avoid repetition the case reports are condensed into legends accompanying the illustrations which the writer believes will cover all the points which have been suggested.

# REFERENCES

- D. M. A. R. I. C. l. l. b. t. t. t. f. d. ble. t. P. d. g. p. bl. t. Am. J. S. g. St. t. N. Y. k. St. t. J. M. 96
- Id. m. St. 33. 4. d. Sc. mm. N. m. thod. f. k. graph. d. g. f. l. d. t. l. g. ry. J. Am. M. 3
- A. 9. 8. K. c. t. m. H. I. A. w. p. d. f. th. l. l. 4. K. a. c. t. m. H. I. A. w. p. d. f. th. l. l. t. f. t. l. t. S. g. C. yn. & Ob. t. 98
5. L. B. 47. 474. R. D. A. w. th. d. g. f. t. l. t. J. U. l. 9. 487. 497. McF. L. D. E. G. P. l. mm. t. S. t. t. f. d. l. l. J. Am. M. A. 97
8. Z. L. R. U. b. tg. l. h. D. ff. t. ld. o. t. k. t. f. t. l. U. t. t. 7. 1. d. d. t. h. R. t. 96

## BILATERAL DOUBLE PELVIS AND URETER WITH ANOMALOUS OPENING OF THE SUPERIOR LEFT URETER INTO THE URETHRA

## CONGENITAL URETERAL INCONTINENCE

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AMONG ureteral abnormalities one although not of very frequent occurrence is more important than duplication or bifurcation. This condition is easily recognized because of its peculiarities. By this I mean the anomalous opening of one ureter out of the bladder sphincter and the resultant continuous dribbling of urine. We have called this special type of incontinence congenital ureteral incontinence. Its typical clinical feature is that although the bladder can be normally voided the patient complains that since birth he has continually lost urine.

These cases are not frequent or perhaps it would be more correct to say that such cases have not been frequently recognized at examination. In many of the cases a diagnosis has been made of true vesical incontinence. I must add however that not every ureter which discharges urine outside of the bladder gives rise to the clinical picture already mentioned.

According to Kelly and Burnam ureters have also been observed which end in a blind sac or open into the bowel (rectum and cloaca, intestine, urachus or amniotic cavity). However I wish to discuss only the cases of anomalous ureters which discharge in the male into the posterior urethra, seminal vesicle, ejaculatory duct, ductus deferens and prostatic vesicle, and in the female into the urethra, vagina, vulva, Gaertner's canal, uterus and fallopian tubes.

I shall only mention the anomalous openings into the bladder because these never give rise to involuntary loss of urine. There is also lack of incontinence in the already mentioned abnormalities in the male because the openings are generally situated above the colliculus so that the external sphincter is able to maintain bladder continence. In the female incontinence is not present if the anomalous ureter discharges into the uterus, tubes or Gaertner's duct. However it is typical when the opening is in the vulva, urethra or vagina. Therefore I would state that only when the ureter discharges into the urethra or vagina does the clinical picture of incontinence exist. The patient since birth has had a continuous involuntary loss of urine while at the same time the bladder function has been quite

normal. These two apparently contradictory conditions seem to indicate the presence of an anomalous ureteral opening. It will not usually be difficult to discover such an opening if a careful examination is made. The discharge of urine often occurring with ureteric rhythm is our principal guide.

The real importance of such an abnormality lies in the great inconvenience which it causes. When incontinence is not present the abnormality is not recognizable and if inflammatory complications do not supervene it has no clinical importance. The majority of these abnormal cases remain unnoticed as is also true in cases of bifurcation or double ureters when no pathological condition exists. Infections and calculus complications occur frequently in these anomalous urinary systems because the congenital malformation leads to stagnation of urine.

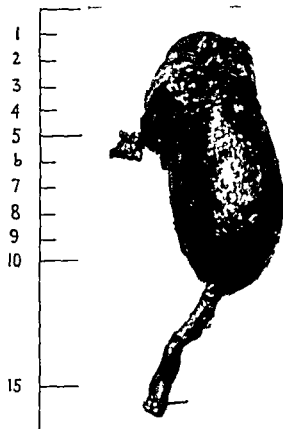


Fig. 1. Superior half of kidney excise.



FIG. 1. Left pelvis

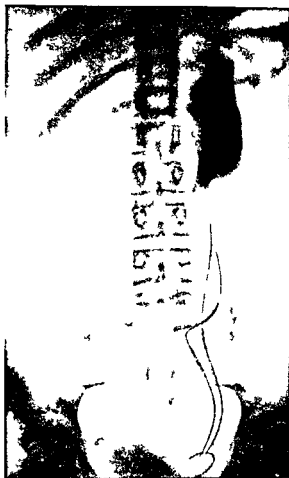


FIG. 3. Left pelvis

In the case which I wish to present there was an anomalous orifice in the urethra of one of the left ureters (the upper one is situated vertically) and also a duplication of the right ureter and a bilateral double pelvis. Such an anomaly is exceedingly rare and I think the case is well worth reporting because as far as I know radical operation (heminephrectomy) has never before been performed in such a case.

A total of 60 cases of ectopic ureteral openings have been reported in the literature with 50 cases of bilateral ureteral duplication. Killane in a very careful paper classifies the abnormality in different types: (1) one ureter with an ectopic orifice; (2) duplex ureter of one side with an ectopic opening of the supernumerary one; (3) bilateral ureteral duplication with ectopic opening; (4) duplication of one side with double kidney and pelvis and with an ectopic opening of the supernumerary ureter; (5) bilateral double ureter and pelvis with one ectopic opening; (6)

bilateral double ureter and pelvis with bilateral ectopic penins and (7) single normal ureters each discharging out of the bladder.

These are the most common. McAcoli who is fully reported in my case has added other cases to those gathered by Killane, i.e., 1 to the 4 of the first type and 9 to the 55 of the second. To the 64 cases of the second type I must now add two other cases published more recently by Giuliani and Puccinelli. Kilbane reports only 14 cases of the fifth type. Mine would be the fifteenth case. Twelve autopsy reports are given and 1 has been observed by Madelung in a girl of 14 years who had a supernumerary left ureter opening into the vagina; no operation was performed.

Only one case that of Alberg has been operated upon. This patient was an 18-year-old girl with a supernumerary right ureter discharging into the anterior wall of the vagina. Alberg thought that there was a vesical fistulous opening and tried to extirpate the sinus which went in the

direction of the right parametrium. The patient died from pyæmia at autopsy it was found that the sinus went to the right pelvis. This case must be considered as having a supernumerary ureter even at the left there was ureteral duplication.

Because of the rarity of my case in the surgical interest I will report its clinical history.

Miss Aurelia T. 14 years of age entered the hospital complaining of a continuous incontinence of urine. It has been present day and night since birth. Her function however is normal and 4 to 6 times a day. She voluntarily voids the bladder at intervals of 15 to 20 minutes. At night she voids at this impulse at night. Family antecedents and personal history are not significant.

**Examination.** The patient's general condition is good and she looks quite healthy. No congenital deformations are to be noted. The thorax and abdomen are normal. The skin of the labia majora and the inner surface of the thighs on their superior third has a process of dermatitis. At regular intervals the ureteric rhythm the urethral meatus opens and a drop of urine comes out. Vesical catheterizing is not possible. Centimeters of urine is obtained.

**Cystoscopy.** The bladder is normal and when it is filled with 250 cubic centimeters of water the patient feels an intense stimulus to void but if told to hold the urine it easily obeys. On the right side the ureteric orifice is seen one is in the normal site the other is a little more medially situated near the internal urethral orifice. On the left side only one ureter is in the normal site. All three openings look quite normal.

**Urethral oscopy.** On the posterior urethral wall very near to the external meatus an orifice looks like a ureteral opening is seen. It looks a little smaller it opens rhythmically and moves rhythmically. Indigocarmine is injected and returns after 3 minutes from the ectopic orifice. No elimination from the extravascular orifice is noted. Two No. 6 French catheters pass freely into both right pelvis. A pyelogram shows two normal pelvis. The ureters cross each other according to the Weirert Meyer law (Fig. 2).

A catheter is easily passed into the left vesical ureter up to the pelvis. From the extravascular opening it is impossible to push it more than 20 centimeter. A pyelogram shows that on this side also there are two pelvis and that the ureters cross each other. The inferior pelvis is corresponding to the bladder opening looks quite normal while the superior one which I drained through the ectopic ureter is much dilated (Fig. 3).

**Operation.** A catheter is passed before the operation into the left normal ureter. Lumbar incision is made as the kidney is very highly placed a resection of the anterior two thirds of the twelfth rib is added. The kidney looks larger than normal. It is composed of two parts separated by a groove especially evident on the anterior surface. The superior part which represents only one third of the whole kidney is composed of a thin layer of kidney substance and by a pelvis as big as a turkey egg drained by a thick and dilated ureter. The inferior part has a normal pelvis and ureter and in this the catheter can be felt. Each section has its own vessels. Those corresponding to the superior portion are very thin. These are ligated and sectioned. The ureter is severed as low as possible that is to say about 2 inches above the bladder and its inferior stump is tied and burned with a cautery. The two kidney halves are separated with a cuneus like incision in the inferior one (Fig. 2). With deep hemostatic mattress stitches and superficial capsular stitches the raw surfaces are brought

together. The fibrous capsule is stripped away from the removed kidney portion and fixed with a few catgut stitches on the kidney stump so as to coat it. After reposition of the kidney the wound is closed with a rubber drain left near the kidney stump. The drain in this case was removed after 3 days. Recovery was uneventful and there was no discharge from the wound. Incontinence disappeared at once.

In reporting the case on which I operated I am above all to draw attention to the clinical syndrome of congenital pyeloid incontinence and to the possibility of establishing a diagnosis and of determining the anatomical conditions. It is essential to determine the number of the ureters and the anatomical and functional conditions of the pelvis and kidneys. Cystoscopy, ureteral catheterization, pyelography, indigocarmine and pythalein test, blood examination and sometimes percutaneous aspiration of oxygen should be employed.

The involuntary loss of urine also is sufficient in itself to justify operating even if no complications are present. However as a general rule the pelvis which corresponds to the anomalous ureter is dilated and infected and the ureter is often found dilated and irregularly shaped (uretero-uronephrosis or uroponephrosis).

The following types of operations can be used:  
1. Simple ligation or section of the anomalous ureter. This is undoubtedly the simplest operation and is reported to be sometimes successful. However it absolutely must not be used when infection is present in the corresponding pelvis. I would never employ this method myself because it leaves behind a portion of ureter and the pelvis as a blind dilated sac which even in the best conditions is subject to infection because of stagnation of urine.

2. Anastomosis of the ectopic and normal ureters. This is often a technically difficult operation and a dangerous one because of the possibility of ascending infection.

3. Anastomosis of the two pelvis. This operation is also a difficult and sometimes impossible one. It ought always to be completed with the ligation of the supernumerary ureter or much better with a high section near the pelvis.

4. The formation of a ureterovesical fistula. This can be done through the ureter by means of endoscopic instruments or by opening the bladder by the suprapubic route. Such an operation is generally very easily accomplished because for a certain length the ureter is adherent to the bladder wall. Regarding the first of these methods I think that used by Hunter is the best. Into the anomalous ureter he passed a catheter the tip of which was coated

with a rubber glove finger which could be inflated. In this way the ureter could be made to bulge into the bladder so that a communication was easily established. The same thing can be done even more easily through a suprapubic cystotomy as in Tauffer and Baum's cases.

5. The severing of the lower portion of the anomalous ureter followed by implantation of the superior stump into the bladder (neostomy). This has been done by the subpubic route with good results. Many times the vaginal or suprapubic route has been used but has seldom been successful. In Hier's case an implantation through the vagina was followed by an ascending infection which at last led to a nephrectomy. I must also add that in the cases reported as cured often after several operations frequently a stenosis of the new opening has been observed.

6. Removal of the anomalous structure. Although a complete cure can be obtained with any one of the already mentioned operations I believe that removal of the anomalous structure is surgically preferable. Naturally if only one ureter with an ectopic opening and one pelvis are present great care must be taken. I believe that in such cases the formation of a vesico-ureteral fistula is more strongly indicated. When a severe infection is present a nephrectomy may be performed if the other kidney functions normally. In cases of double ureter and pelvis the operation of choice is heminephrectomy.

Total nephrectomy which has occasionally been done is certainly a much simpler operation but it is recommended only in cases of severe infection of the supernumerary pelvis with diffusion into the kidney substance or in the presence of a unique pelvis.

If as it usually happens in addition to a double pelvis there is a double vessel pedicle and the two kidney halves are separated (very often as in my case there is an evident groove) a heminephrectomy is preferable. The superior portion is usually the one to be removed because according to the Weir-Meyer law the lower

ureteral opening will drain the superior kidney half. M. Ascoli who has widely searched the literature has found this operation reported only 10 times. My case is the eleventh and the first one of bilateral duplication with an ectopic opening. Even in Gaudiani's more recently published case heminephrectomy was performed. The number of operations therefore is 12 and in all of these the result has been good.

As to technique I wish to draw attention to the way in which I separated the fused kidney into its two halves corresponding to the already mentioned groove. A wedge incision was made in the inferior healthy portion which was to remain in place so that it was very easy to bring together the two raw surfaces of renal substance and to suture the fibrous capsule tightly (Kuemmel). I think that it is also very advantageous to coat the sutured kidney stump with the capsule stripped away from the excised kidney portion. The suture so covered assures a better hemostasis and protection against an eventual filtration of urine.

## BIBLIOGRAPHY

- B. (1904) N. J. d. R. J. d. l. 9. N.  
C. R. O. R. y. S. M. l. 5. N.  
D. J. U. l. 9. 3.  
I. L. A. d. l. R. I. d. 9. 5. N. 5. 3.  
F. R. A. Y. K. St. t. J. M. l. 9.  
I. L. m. J. U. l. 9. 2.  
C. A. m. N. A. h. tal. d. h. 19. 7. v. 468.  
C. i. R. d. C. A. i. A. J. d. U. l. 9. 5.  
H. J. s. t. R. Bro. d. D. R. I. d. 9.  
H. f. Z. t. h. f. U. l. 9. v. 6.  
H. m. J. U. l. 4. v. 4.  
H. m. H. t. l. t. d. l. 9. 5. l. 45.  
K. i. t. S. g. C. v. & O. l. t. 9. 6. l. N.  
L. i. s. Z. t. f. u. l. Ch. l. N. 3. 4.  
M. c. R. S. h. m. d. W. h. h. 9. 4. l. 34.  
J. R. m. v. Z. t. h. f. r. l. Ch. 9. 4.  
R. & C. i. R. l. 9. 3.  
R. E. i. f. N. d. l. d. t. i. j. d. h. g. k. 9. 5. l. N. 9.  
S. E. o. l. Z. t. l. b. l. f. G. y. a. k. 9. 2. 3. l. N. 50.  
W. 5. R. R. A. S. 6. q. l. x. N. 6.  
W. R. Z. t. ch. f. l. Ch. 9. 4.

## UTERINE STERILIZATION

By WILLIAM O'NEIL SHERMAN, M.D., F.A.C.S., PITTSBURGH

IN an address on "Sterilization of Wounds and Treatment of Suppurating Wounds and Osteomyelitis (Carrel Method)" delivered by the author before the Royal Society of Medicine in London October 31, 1916 (4) attention was called to the possibilities of treatment of infection of the uterus by the Carrel method.

A visit to the clinics of Carrel and DePage in July 1916 gave the impression and conviction that the problems of wound infection had been satisfactorily solved. A rational debridement of wounds within 8 or 10 hours after the receipt of the patient followed by chemical sterilization with sodium hypochlorite (Dakin's solution) with primary or secondary closure resulted in union in a majority of cases so treated. The results of the Carrel-Dakin treatment when compared with those of other procedures make it the method of choice especially by those who have had the opportunity and have given the time to study and master its technical details. Its general adoption has been greatly retarded because of superficial observations and scanty consideration of the basic principles involved by visitors to the Carrel and DePage clinics without a distinct understanding of the underlying surgical, chemical, pathological and bacteriological principles.

The great lack of understanding and the failure to carry out details as well as the modification by surgeons who do not understand the method are the chief causes today of the general misunderstanding and the great divergence of opinion as to the merits of sterilization of wounds with sodium hypochlorite.

The great similarity between wounds of war and uterine infection gave rise to the hope that if a satisfactory technique could be devised progress would be made in the treatment of uterine infection. Wounds produced by shells which introduce into the tissues foreign bodies contaminated with soil pollutions together with the trauma of the soft parts present very much the same picture as the postpartum or postabortion uterus with its retained secundines, proliferated mucosa and blood clot together with the exposure of the raw surface of the uterus at the placental site.

In the great majority of cases uterine infection at its onset may be considered as local or superficial while involvement of the parametrium, broad ligaments, peritoneum and blood stream

is a later and secondary extension. It would appear logical to assume that if effective treatment were directed before such extension of the infectious process, arrest or even suppression of the infection can be secured.

The author early recognized the great possibilities of sodium hypochlorite in the treatment of localized infections such as uterine sepsis and in the aforementioned paper briefly advocated a technique whereby it would be possible to apply the Carrel principle to the treatment of uterine infection.

With this in mind the author devised a special instrumentarium consisting of vulcanized cervical pessaries perforated rubber tubing introducer, uterine sound and packer. A brief description of the apparatus was given in this earlier publication (3).

The principle of the treatment consists in the gentle introduction of the pessary into the cervix followed by the introduction of rubber tubes through the pessary into the uterine cavity and the packing of the uterus lightly with bandage gauze so that the tubes are retained in position against the walls of the fundus. They give the appearance of the steel ribs of an open umbrella. The gauze acts as a sponge and gives off to the uterine walls the hypochlorite solution as it is ejected from the rubber tubes. Should it be deemed advisable to remove some of the retained secundines this may be done in the early cases provided great caution is observed not to traumatize the mucosa by curettage or instrumentation. It is more conservative to use a small cotton sponge on a holder and by this means excessive debris can be gently and sufficiently removed. Curettage absolutely fails to remove all of the infected tissues and usually is provocative of great harm by setting up active extension of the infection. For this reason curettage is generally inadvisable.

In this paper I do not wish to discuss the many factors entering into the cause and prevention of uterine sepsis but rather to direct attention to the great similarity in the pathology of uterine infection and that of general surgery with the hope that the principles and methods used in the latter field to combat infection will be applied to related obstetrical problems.

One great difficulty in the treatment suggested is the frequent inability to retain the tubes within

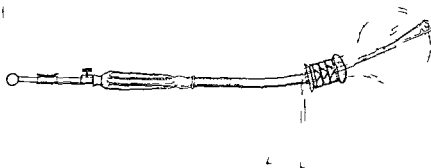


Fig. 1. Hand-drawn illustration of a medical instrument, likely a uterine sound or curette, showing the handle, shaft, and the curved, looped tip.

the uterus when contraction begins. The tendency is for the tubes to be forced into the vagina. It must also be admitted that the treatment is applicable only in early selected cases and in hospitals where every possible facility is available to carry out each detail of the method. Because of the dangerous extension of infection following ill advised or anything but the gentlest of manipulations this treatment should be attempted only by those who have specialized in this work and who have made a careful study of the principles involved.

It is quite true that many patients with puerperal infections are frequently seen only in the late stages when active intervention is contra-indicated. Therefore it is imperative that physicians, nurses, midwives and the laity be educated to the necessity of active treatment at the earliest possible moment so that immediate steps can be taken to abort or suppress local infection before it becomes general or systemic. Cases in which unnecessary and careless examinations or intensive instrumentation have been made and in which infection is probable should be treated prophylactically immediately following delivery and before signs of local infection become apparent. It must not be forgotten that in the fulminating types blood stream infection and death occur before local symptoms are evident and before any measures can be instituted.

It is conceded that there are causes for pyrexia in the puerperium other than infections of the uterus. If the temperature rises to 100 or 101 degrees F, pulse increasing from 105 to 110 together with the presence of bacteria on smear and culture taken from within the uterus treatment should be started at once. The diagnosis of uterine infection should be made only by a process of elimination after every other possible factor such as focal infection, pulmonary or abdominal disturbance, mastitis, plebitis, cystitis

etc. has been excluded. To delay and hesitate in an effort to differentiate between sapraemia and a true uterine infection is likely to result fatally. It is usually impossible to differentiate in the early stages between them and it is generally admitted that a sapraemia frequently merges into septicæmia.

There is no doubt but that the indiscriminate use of antiseptic intra uterine douches has produced much harm and has been of no benefit in the treatment of uterine infection. It is obvious that the best treatment is prevention. Despite exacting precautions and the very best of surroundings however infections not infrequently occur. Too often are the attending doctors and nurses censured when every care has been taken and blame is unwarranted. On the other hand there are many cases of infection due to repeated examinations, faulty technique and unsanitary surroundings, all of which is more or less within the control of the physician or nurse.

The question of puerperal infection is a serious one and demands the attention of the profession as there has been little or no reduction in uterine sepsis and mortality during the past 30 years. Whitehouse indicates little change from 1883 to 1902 and from 1911 to 1912 in mortality.

#### GENERAL PRINCIPLES OF THE TREATMENT OF PUERPERAL SEPSIS

The most generally accepted plan is that of watchful waiting as against direct intervention. Active treatment (curettage or intra uterine douching with useless antiseptics—mercury salt, iodine, the phenol group, silver salts) has resulted in absolute failure to cure and such treatment is more likely to be the cause of a dissemination of the infection.

During and previous to the war the general failure of all antiseptics other than sodium hypochlorite to abort or cure infections resulted in

the division of the profession into two groups those who had faith in antiseptics as inhibitors or destroyers of infection and those who believed in the physiological treatment of wounds and infection by saline irrigation and aseptic technique. Notwithstanding the fact that tincture of iodine solutions of mercury salts and the phenol groups failed absolutely to combat infection during the World War thus resulting in a great loss of life and frightful disabilities there are those today who doggedly continue to treat infected wounds in the blind faith that these useless so-called antiseptics are specifics.

The present general status of the expectant method is largely dependent upon the vital forces of the patient i.e. if there is sufficient resistance to overcome the infection recovery is possible the patient receiving very little in the way of medical assistance. About the only active treatment is the use of ergot elevation of the patient for drainage, ice to the abdomen rest avoidance of cathartics and such measures.

#### LOCAL TREATMENT AND TECHNIQUE

No attempt will be made to discuss in this paper other therapeutic measures of admitted value but attention in the early stages is to be directed toward methods of sterilization of the uterine cavity.

The patient is anesthetized preferably with ethylene or nitrous oxide and placed in the lithotomy position. The external genitals are cleansed with soap and water in the usual manner and vaginal irrigation with  $\frac{1}{4}$  of 1 per cent solution of sodium hypochlorite is given. Picric acid iodine peroxide ether or alcohol are not to be used as they are incompatible with sodium hypochlorite. Careful inspection of the vagina and cervix should be made followed by a gentle bimanual examination to determine the size and position of the uterus.

The cervix is grasped with a single tenaculum and with the blunt uterine sound of the author's design the distance between the fundus and external os is measured as well as that between the internal and external os. Subtraction of the difference between the length of the cervix and the measurement from the external os to the fundus gives the distance within the uterus that the perforated rubber tubes can be introduced. For purposes of safety and to prevent any possibility of perforating the fundus with the metallic intra-uterine introducer a further reduction of from 2 to 4 centimeters should be made. This will allow ample distance for the placement of the tubes within the uterus without perforating the fundus.

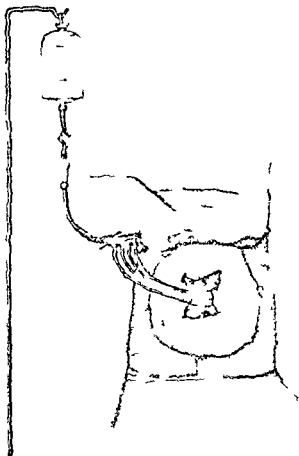


Fig. 2 Vaseline gauze dressing applied to perineum to prevent irritation. Rubber tubes attached to Carrel glycol distributor and container solution is introduced into the uterus by the drop method.

At the same time the width of the cervical canal should be carefully estimated so that a pessary may be selected which will be small enough to pass without the slightest dilatation or other traumatic force.

The perforated rubber tubes are then placed in a proper sized pessary a sufficient number of staggered perforations being allowed to permit a free outflow of the hypochlorite solution from the tubes over the entire surface from the external os to the fundus. When the tubes are threaded into the pessary sufficient length must be left so that their ends will reach to the vaginal outlet.

The introducer is then placed in the central opening of the pessary where it grasps and locks the distal ends of the perforated tubes. After it has been determined how far the tubes are to be introduced within the uterus a set screw on the handle of the introducer is adjusted and the rubber pessary is carried into the cervix the tubes are passed up into the cavity of the uterus until the introducer engages with the set screw. The introducer is then released from the perforated tubes and withdrawn from the pessary. The tubes are



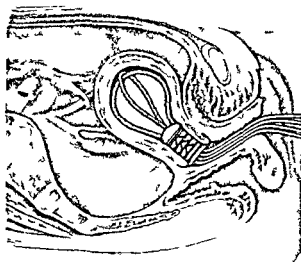


Fig 3 P t d t th p f t d l  
b t b p g th t w th l h t a p k p  
m t t g t l l t f hypochl t l t l p d k  
m p l d f d a

left placed within the uterus and the pessary *in situ* within the cervical canal.

The pessary presents its outer surface at the external os. Through the central opening of the pessary bandage gauze is packed lightly into the uterine cavity in such a manner and quantity that the cavity is entirely filled with gauze. The lower end of the bandage lies free in the vagina. The tubes are thus held in position against the fundus and walls of the uterus, the gauze serving as a sponge which constantly holds and gives off the sodium hypochlorite to the uterine walls.

A small projecting shelf at the orifice of the pessary permits if desired the fixation of a rubber dam cover which encases the tubes and drainage gauze so that the vagina is protected against any possible irritation from the hypochlorites. This step complicates the general technique and is not essential. In the presence of a vaginal tear with ulceration or infection such protection might even be undesirable and extravaginal tubes may be placed as indicated.

It must be remembered that the object of uterine gauze is to act as a sponge and if packed tightly it will take up too little of the solution in suspension. The special packer designed by the author is used to introduce the gauze into the uterus. The skin of the external genitals is protected by vaseline strips of gauze and a large absorbent pad of cotton and gauze. The irrigation tubes placed within the uterus and presenting

at the vulva are attached to a glass distributor which in turn is connected with a large rubber tubing from the container holding the hypochlorite solution. This container is elevated 3 feet above the head of the patient and the solution is allowed to flow from the container when a stop cock is released. Seepage of the hypochlorite solution is observed at the vaginal outlet. At intervals of every hour in day time and every 2 hours during the night from 4 to 8 ounces should be instilled. The solution must be injected under pressure but not enough pressure should be used to force the solution through the fallopian tubes into the abdominal cavity nor should the solution be instilled by the drop method as is saline in the Murphy drip.

Sodium hypochlorite liquefies the retained secretions and bacteria by a process of oxidation and ample outflow is permitted through many drainage holes in the cuff of the pessary. As the uterus recovers its tone and contracts we must expect difficulty in retaining the tubes *in situ*. The bandage gauze in the uterus may be changed every 14 but the tubes and pessary need not be changed oftener than every second or third day. As the uterus involutes smaller pessaries must be used. If the temperature and pulse fail to show marked improvement within 5 to 7 days treatment should be discontinued and failure admitted. There will usually be quite a visible change for the better within 3 or 4 days provided the treatment is started while infection is still localized within the uterus.

The cervical pessaries are made in 4 sizes with different sets of introducers and 2 sizes of rubber tubing. It must be understood that extreme gentleness must be exercised at all times and trauma is absolutely avoided.

#### CHEMICAL PHYSIOLOGICAL AND BACTERIOLOGICAL PROPERTIES OF SODIUM HYPOCHLORITE

The solvent and antiseptic properties of Javelle water and Libarrague's solution were long known but they were too caustic to permit of their surgical use while the ineffectiveness of iodine mercuric silver salts and the phenol group have been discussed elsewhere in this paper. It remained for Dakin and Daufresne to devise a method of utilizing sodium hypochlorite of known content in so far as its percentage of sodium hypochlorite was concerned and of relatively low alkalinity.

By the use of 5 per cent active chlorine (bleaching lime) with the addition of sodium bicarbonate a solution of constant hypochlorite content (45 to 5) known as Dakin's solution was accepted as a standard for surgical use. The phenolphthalein

test of the alkalinity is not a reliable chemical test as to exactness and can be only a relative indicator. The hydrogen ion content is generally accepted as the most reliable index of alkalinity. A 45 to 5 sodium hypochlorite solution is made from bleaching lime has proved to be an excellent solution when used in connection with the Carrel technique. It requires however constant testing because of its instability. It is rather difficult to make or secure a reliable Dakin's solution in the vast majority of hospitals. The hypochlorite solution of greatest stability and lowest alkalinity when combined with sodium chloride makes an almost ideal antiseptic solution because of its bactericidal and physiological properties.

The great superiority of sodium hypochlorite over other antiseptics is due not only to its antiseptic properties in destroying bacteria but also to its property of dissolving necrotic tissue. A 4 per cent solution of sodium hypochlorite will destroy anthrax and its spores immediately, a dilution of 1 to 10 will destroy anthrax bacilli and spores in 15 minutes.

What is the chemical action of sodium hypochlorite when it comes in contact with bacteria or with dead tissue? The chlorine of the aqueous hypochlorite has great affinity for the nitrogen of the proteins setting free nascent chlorine and forming a chloramine. The affinity is so great that the hypochlorite is practically used up within 5 to 10 minutes after its injection into the wound, this being the reason why repeated injections at such frequent intervals are so necessary. Sodium hypochlorite in proper dilution is non-toxic and can be used in any quantity. The author has used 10,000 cubic centimeters during a period of 4 hours in the treatment of empyema with no deleterious effect. It has little or no destructive effect on living tissues in proper dilution but seems to have a selective action for bacteria and dead tissues and is the only great oxidizer at the present time available which can be used freely without danger of injuring or destroying living tissues.

The ideal solution to be used is one that is isotonic combination of Dakin's solution with low alkalinity and saline content: sodium hypochlorite 5 per cent, sodium chloride 7 per cent and aqueous distillate 98.8 per cent.

Chemical sterilization of the surface of living tissue is but a relative term, i.e., reduction of 1 to 2 bacteria to 5 microscopical fields, this average being made from an examination of 20 or more fields. The few remaining bacteria which have not been destroyed by the hypochlorite can be well cared for by the phagocytes and leucocytes.

If sodium hypochlorite can sterilize large empyema cavities, compound fractures and joints it is not too much to expect it to bring about similar results in the uterus if used with discretion and full understanding.

In an editorial in the *British Medical Journal* on Listerism and War Wounds a review of antiseptics is briefly mentioned. The editorial states: At the outbreak of the war of 1914-1918 surgeons were far better equipped in knowledge and resources than in pre-antiseptic days. Yet early experiences with gunshot wounds were so disturbing that a feeling of dismay at their inability to check virulent infection swept over all. Were our teachings fundamentally unsound? Had we forgotten the lessons we thought we had learned? The obvious thing was to go back to Lister. To add to the general discomfiture a most respected bacteriologist wrote most convincingly on the futility of antiseptics in general. New antiseptics were sought and discovered. Eusol came in, then the Carrel-Dakin treatment. The latter certainly would have made a strong appeal to Lister himself. In it is fulfilled one of the principles for the application of which he searched so long: the continuous renewal of an antiseptic which had no marked deleterious effect on the tissues. Wound excision at the earliest possible moment with primary union delayed or primary suture as the wounds demanded antiseptic treatment, Carrel-Dakin—these were the principal methods finally adopted—is a routine. But it required fully three and one-half years of their evolution on an unprecedented mass of human material.

This editorial is in error as to the time of evolution before its acceptance as routine procedure. It has not as yet been accepted as a routine measure and when presented in 1915-1916 to many so-called leaders of the profession it met with rejection so it has been only by slow stages that the true merits of the method finally have become known. Even today adverse criticism and strenuous objections are frequently encountered. It will no doubt take many years to break down the prejudices and theories before a general acceptance and understanding can be expected. In the interval many lives will have been sacrificed unjustly. One is curious to know how much more unprecedented mass of human material is necessary to convince the skeptical.

The aqueous hypochlorite solutions with low alkalinity known as Dakin's solution must not be confused with the chloramines, dichloramines and similar synthetic products which are derived from coal tar. Chloramines and dichloramines

TABLE I

N mb t f	D t - f
8	2
3	3
9	4
6	5
8	6
8	8

have little or no solvent properties. It is the great solvent property of aqueous hypochlorites which makes them so useful. It must not be inferred that any of these or cure all is being offered.

## FREQUENCY OF PUERPERAL SEPSIS

Fothergill states that in a report of Queen Charlotte's Hospital in 1911 dealing with 1700 cases of which 234 were febrile 134 cases 8.6 per cent were regarded as puerperal pelvic infection. Two of these patients died a fatality of 1.57 per cent.

A study of British Maternity Hospitals show that the number of cases of pelvic infection varies from year to year but it appears that 6 to 8 per cent of such infections occur of which 3 to 4 per cent die in other words out of every 1000 confinements we may expect 60 to 80 cases of infections with 2 or 3 deaths.

In a careful analysis of 3500 deliveries in the United States Euno reports 300 infections and 10 deaths i.e. 8.6 per cent infections and 3.5 per cent fatalities.

The estimated number of births in England and Wales in 1920 was approximately 957,787. 7 per cent were infected or 67,000 cases of puerperal infection and 1,087 deaths from puerperal sepsis were registered in that year. In addition to the births there were about 2 abortions to every 7 confinements. Thus there would be 10,000 additional cases of infection after abortion to arrive at a total of puerperal pelvic infections which would make 70,000 to 80,000 cases in England and Wales during 1920.

These statistics being used as a basis it is evident that if the same ratio of infection and births existed in the United States there were 186,232 cases of uterine infections and 5,587 deaths. In his report on Uterine Infections in the United States De Lee says that 6,000 women die annually from puerperal infections in this country.

An estimate of the population of the world in 1920 was 1,748,000,000. If the same ratio existed throughout the world in the same year there would have been 3,059,000 infections and 91,770

TABLE II—COLLECTED SERIES OF CASES

M b d	C	D th
M A d d s ( ) y h d l rubb r yr	152	9
T R C mpb ll C y ( ) rubb tubi g		
with t ru	30	
B ckwith Wh t h l g rubbe dra		
g t b i t d to t ru d s t ed		
t l b	6	5
P l T t th s a m ment r m nd		
J q ch q	8	
J q S lb l (5) C l tub s c ed into		
th t ru		
P C lt b c d t theute s	6	
T t l	59	26

deaths. These statistics are rough estimates but are not necessarily exaggerations of actual conditions. The death rate for puerperal sepsis in the United States per thousand births is 2.79 or 1 in every 407 and our registration is far from complete.

M. Androdias, professor in obstetrics and gynecology at the University of Bordeaux, France, in a report of a series of infections treated by the Carrel Dakin method states that 133 patients recovered in from 10 to 25 days after confinement the average being from 12 to 15 days. Irrigation was discontinued as the temperature came to normal. Table I gives an idea of the duration of the irrigation.

The author suggested this treatment to Dr. Paul Titus, an obstetrician in Pittsburgh, and asked him to make a thorough trial of the specially devised instruments and technique. This was done and he has made a personal communication setting forth the results in 8 cases thus treated.

Titus was able to reduce the temperature and bacterial count of the lochia to normal within 4 to 8 days after chemical sterilization of the uterus was begun notwithstanding the fact that the treatment was instituted 2, 3, 4, 6, 10 and 11 days respectively after the initial rise of temperature. The cultures were carefully taken by means of intra uterine culture tubes and in each case the bacterial count per microscopic field was 60 or more bacteria at the beginning of treatment. In every case in which the treatment was indicated and used there was a material decrease in the number of organisms within 3 or 4 days. In one patient the manipulations caused a definite extension of the infection into the cellular tissues of the pelvis and suggested to Titus that the indications for this treatment are limited after infection is frankly established to the so-called putrid or shaggy puerperal endometritis cases.

The most favorable cases are those in which the infectious process remains localized and is not of more than 7 or 8 days standing. In such cases the technique is carefully carried out, the result shows definite improvement in 10 days.

He also states that the treatment is ideal and exceedingly simple in instances of vaginal lacerations and infected perineal sutures. Many times union will still result in a stitched perineum so badly riddled with infection that complete separation and relaxation would ordinarily follow.

Following is a brief summary of the cases treated by Dr. Titus:

**CASE 1.** Mrs. M. McC. No. 6 had a normal delivery with slight fever on February 19, 1911. She had a chill on the third day and her temperature was 104 degrees and her pulse 110. On March 1 the uterine material showed a bacterial count of 600 above per microscopic field. Diplococci per microscopic field. On March 6 perineal and tubal tubes were inserted. Blood count showed 1000 leucocytes. M. H. perineal tubes were reinserted there were 1000 bacteria per microscopic field. March 9 the blood count showed 1000 leucocytes. March 11 there was an average bacterial count of 6 per microscopic field. March 13 the blood count showed 1400 leucocytes. March 14 the perineal tubes were removed. March 15 and 16 the temperature and pulse were normal. No blood culture was taken.

**CASE 2.** Mrs. J. A. No. 6-A had an incomplete abortion followed by criminal introduction of a boy. On March 4, 1911, the fever was passed. The patient had a chill and fever during the night and considerable hemorrhage. The next day she was not seen by the hospital service. Her temperature was 101, pulse 110. At 10:00 p.m. a foul smelling placenta and membranes were removed under anesthesia. Perineal and tubal tubes were inserted followed in the operation. The uterine bacterial count showed 600 more bacteria per microscopic field. The blood count was 14,600 red blood cells and 19,400 leucocytes. On March 11 the tubes and perineal tubes were changed. Temperature and pulse were normal. The patient's condition was quite satisfactory.

**CASE 3.** Mrs. E. F. No. 494 had a normal delivery on December 1916. On January 1917 the patient's temperature was 101 degrees and her pulse was 110. On January 3 the temperature was 104, pulse 160. A normal meconium was passed. Gram-negative diplococci 60 or more to the field. There were probably gonococci. January 9 the perineal and tubal tubes were inserted and were reinserted with change of gauze on January 10. On January 11 and 12 the temperature and pulse were normal. Temperature was 100 degrees, pulse 106. February 4 the temperature was normal.

**CASE 4.** Mrs. Anna M. No. 636 was delivered on March 14, 1911, at home. On March 1 the patient was admitted to the hospital and her case was diagnosed as pneumonia with local peritonitis and pleural effusion. The temperature was 103.6, pulse 140. A blood count showed 1000 leucocytes. March 18 cultures were taken from the uterus. Retained secundines and remains of small blood clot were very foul. Perineal and tubal tubes were introduced. Laboratory findings from the uterine material showed a bacterial count of 600 or more bacteria per microscopic field. On the next day there were 3 bacilli per microscopic field. 3 diplococci per microscopic field and a few streptococci. The blood culture produced a growth of bacilli, proteus

bacillus. Leucocyte count was 1000. March 19 bacterial count showed 60 bacteria or above per microscopic field. Bacilli, diplococci and red blood cells. On the next day there was a growth of bacilli, streptococci, bacillus. Leucocyte count was 1000. March 20 the bacterial count showed 60 or more bacteria per microscopic field. Bacilli and diplococci were found on the meconium. Bacilli, proteus and bacillus were found in the culture. The leucocyte count was 1000. March 21 the blood cultures were negative. The leucocyte count was 1100. Leucocyte count on March 21 was 1000. March 22 the bacterial count showed 60 or more bacteria per microscopic field. On the next day there were red blood cells, cocci and bacilli. The leucocyte count was 600 and the next day it was 1000. The bacterial count on March 6 showed 6 bacteria per microscopic field. On March 10 there were no organisms. The blood cultures were negative on March 21 and April 10. The leucocyte count was 1100. On April 11 the temperature was normal and the pulse was 110 to 120.

**CASE 5.** Mrs. J. R. H. No. 618 had a normal delivery on December 1916. On January 1917 a breast abscess was noted. Temperature was 104, pulse 110. January 13 there were 60 bacteria to the microscopic field. Perineal and tubal tubes were inserted and then reinserted on January 14 and 19. January 19 the bacterial count was negative and the next day the temperature was normal. On January 22 the tubes were removed.

**CASE 6.** Mrs. H. No. 610 was admitted to the hospital on the eighth day of puerperium. On March 31, 1911, there was a postpartum delivery. On April 1 the patient had a chill with rise of temperature to 101 degrees. April 4 and 5 the temperature was 101 degrees. April 12 the patient was admitted to the hospital. Perineal and tubal tubes were inserted at once and reinserted April 13, 14 and 15. April 15 the uterine culture showed 60 or more bacteria per microscopic field. The next day showed pneumococci and bacilli. The growth was taphylococci. The blood culture was negative and the leucocyte count was 13,000 on that day. April 16 the bacterial count was 60 or more per microscopic field. The meconium showed taphylococci. There was no growth. The leucocyte count was 1000. The bacterial count on April 11 was 60 or more per microscopic field. The next day showed no growth. Blood culture was negative. April 17 there was an average of 6 bacteria per microscopic field. The leucocyte count was 16,600. April 14 there was an average of 1 bacterium per microscopic field. The temperature was normal on April 15.

**CASE 7.** Mrs. Amelia H. No. 610 had a forcep delivery with slight vaginal tear and three sutures on February 6, 1911. On the fourteenth the patient had a chill and a temperature of 103.5 degrees. Pulse was 113. Perineal and tubal tubes were inserted on the fifteenth and reinserted on the eighteenth and nineteenth. Bacterial count from the uterus showed 60 or above per microscopic field on the fifteenth. The leucocyte count was 13,000. On February 15 there were 4 or more bacteria per microscopic field and the leucocyte count was 1000. The next day the leucocyte count was 13,300. On the twentieth there were 8 or above bacteria per microscopic field. The material was obtained direct from the uterus by means of a glass catheter and 5 mm. Each specimen produced an average of pus streptococci. The second culture showed an average of only diplococci to the field. The third specimen showed short-chained streptococci averaging 10 chains to the field. There were 1000 leucocytes. The next day a leucocyte count was taken and showed 14,600 on the twenty-second. The count showed 1400 and the next day it was 1000. On February 23 the perineal and tubal tubes were removed. On February 24 the patient's temperature became normal.

LOCHIAL CHANGES

In 1919 Professor Perrozi (8) in discussing Microbes in Lochia in cases treated by this method states The lochia in puerperal women examined by me was ordinarily cleared of bacteria in the first and second days following labor On the third day in the presence of infection there was a sharp rise in the percentage of bacteria (100 to 400 to every microscopic field) The most favorable time for starting the Currel irrigation was in the first period i e the incubation period In the less serious cases 4 or 5 days were sufficient to sterilize the uterine cavity in the more severe cases it took 7 or 8 days

If there is not a progressive diminution of the bacteria or should they remain at the same level one should look for some error in technique Possibly the tubes are kinked or obstructed and closed by the presence of blood clots There is a tendency during the first few days for the lochial secretions debris blood clot etc to clog the irrigating tubes When the pressure in the container is increased free egress of the solution from the tubes can be secured The gross characteristics of the lochia change rapidly so that within 4 or 5 days it is a scanty thin transparent secretion free from odor With this change there is usually general systemic improvement due to the diminution of septic and toxic process

Bacteriological examinations of lochia and retained contents should be made at each dressing They will be of great assistance when studied in conjunction with clinical evidence in deciding when the infection is under control

Bacteria appear very abundantly in the febrile puerperium after 24 to 36 hours and the color is usually the last bacteria to disappear

CONCLUSIONS

1 Irrigation of the uterus with 5 solution of sodium hypochlorite of low alkalinity in combination with hypertonic saline solution destroys bacteria and dissolves blood clot placental tissue and debris without destroying living tissues and leucocytes

2 If started early this treatment may arrest local infection and prevent extension to adnexa and blood stream

3 Septic endometritis puerperal or postpartum has been cured by the intermittent irrigation of the uterus with sodium hypochlorite solution

4 Repeated bacteriological examinations which are recorded on bacteriological charts are contributory evidence of the state of the infectious process

5 This method of treatment should be used only in well equipped hospitals by skilled operators because special technique and armamentarium is necessary and keen judgment is required in the selection of cases Moreover ill advised or carelessly performed attempts at such treatment will cause traumatic extension of the uterine infection

6 The treatment is most useful in the so called putrid or shaggy puerperal septic endometritis of mixed bacterial origin with marked subinvolution of the uterus If extension to the parametrium has occurred or is suspected attempts at the treatment should not be undertaken

PERFORATIONS

C N J R C S m u t n the t m t of  
 pu rp l p B t M J Lo l o 4 1 156-358  
 COUSVN A D t m t d l fect on uté p t  
 p t m p r l r t d cont l l d l q de  
 d D k P d u p a  
 DEL E J B S l e r y d y b tet probl m lm  
 J Ob t q l 5 2  
 Ed t l Li t mand w d B t M J 9 4  
 EN L Pu rp l mo b d ty S g Gy ec & Ob t  
 F 9 3 70 80  
 M J 10 4 7 3 774  
 PERAZZ P N t c t l g i h e l h R g n a d t t  
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 SH RM N W O N Ste l at f p purat g w l  
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 M d Lo d S t S r g 9 6-7  
 Id m Th C l m th d f w u d st n l z t o n Su g  
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 S L J L l é f d gu r d l h r u g l l  
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 WHIT ts B P rp l p its p e v t d d  
 t m t Lan t L d 19 4 09 109

# ARE PICRIC ACID AND MERCUROCHROME SOLUTIONS LOCALLY ANÆSTHETIC?

By DAVID I. MACHT, M.D., LL.B., BALTIMORE, MARYLAND

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PICRIC acid and oxymercuridibromfluorescein have been used considerably in the surgical treatment of burns the former having been employed for a longer time than the latter. Solutions of these two drugs are highly colored and stain the skin. Picric acid solutions of 0.5 per cent or stronger have been painted over or applied as in dressings over burnt surfaces and according to some authors have been found to be exceedingly efficacious. Thus Hare in his *Practical Therapeutics* states:

It has been found exceedingly efficacious in solution in the treatment of severe burns and scalds. The same author also speaks of 5 per cent solutions of picric acid as being antiseptic so that it may be used to disinfect the skin. It is well known however that this chemical when absorbed into the system will produce renal irritation and other signs of poisoning so that its use over extensive areas and in cases of deep burns is contra-indicated as absorption might occur and lead to poisoning.

In the last few years various surgeons have been employing solutions of oxymercuridibromfluorescein or mercurochrome 220 soluble not only as an antiseptic but also as a dressing for burns of the first and second degree. Application of this drug has been claimed to be beneficial not only by virtue of its powerful antiseptic properties but also as a relief to the pain following burns and scalds. Mercurochrome poisoning by absorption from the skin has never been reported and in general the toxicity of this drug is much less than that of picric acid (7). In connection with these uses of picric acid and Mercurochrome 220 soluble the author deemed it desirable to inquire into the mechanism of their sedative effect on burns and scalds and more particularly to ascertain whether these solutions exhibit any locally anæsthetic properties on the nerve endings of the affected areas.

The methods employed in this experimental study were the well known classical procedures for determining and analyzing the local anæsthetic effects of drugs. Three methods were tried in the present study. In the first series of experiments the local anæsthetic effects of the drugs were studied on the sensitivity of the rabbit's cornea. The reflexes following the touch

ing of the cornea before and after instillation of the solution into the conjunctival sac were studied. By this method no evidence of local anesthesia was obtained after instillation of either dilute picric acid or mercurochrome solutions. In this connection it was found that picric acid by virtue of its acidity was much more irritating to the eyes than mercurochrome solutions. Indeed mercurochrome has been employed successfully in ophthalmological practice by Clapp and Martin (1), Burnett and Gaus (4), Criddle (3), Boeckmann (1) and others.

In a second series of experiments the anæsthetic properties of the solutions were tested by the frog skin method. As is well known to all physiologists and pharmacologists this method is practiced as follows: The brain of a healthy frog is pithed but its spinal cord is left intact. The frog is then suspended and each leg is dipped into a weak solution of acid. The irritation of the acid on the sensory nerve endings of the skin produces a reflex retraction of the limb from the beaker containing the acid solution. The skin is then washed off by dipping several times in fresh water. The same limb is then immersed for a definite number of minutes into the solution to be tested and after the given exposure to the unknown solution its response to irritation by the acid is again determined. In this way it can easily be determined whether or not a local anæsthetic effect has been produced. Such a local anæsthetic effect is due practically entirely to a local action on the skin there being very little absorption into the general circulation in the short time through which the experiment is performed. The author has repeatedly tested solutions of picric acid and mercurochrome 220 soluble for their local anæsthetic effects according to this method and in no instance was any local anesthesia produced by the drugs even after an exposure of 15 minutes.

The third method of investigation was the study of the effects of the solutions on the conductivity of sensory and motor nerve fibers according to the well known pharmacodynamic methods described in treatises on experimental pharmacology. The experiments performed were made on the sciatic nerves of cats and dogs. After the exposure of the nerve and the cleaning of its

LOCHIAL CHANGES

In 1919 Professor Perrozi (8) in discussing Microbes in Lochia in cases treated by this method states The lochia in puerperal women examined by me was ordinarily cleared of bacteria in the first and second days following labor On the third day in the presence of infection there was a sharp rise in the percentage of bacteria (100 to 400 to every microscopic field) The most favorable time for starting the Carrel irrigation was in the first period i e the incubation period In the less serious cases 4 or 5 days were sufficient to sterilize the uterine cavity in the more severe cases it took 7 or 8 days

If there is not a progressive diminution of the bacteria or should they remain at the same level one should look for some error in technique Possibly the tubes are kinked or obstructed and closed by the presence of blood clots There is a tendency during the first few days for the lochial secretions debris blood clot etc to clog the irrigating tubes When the pressure in the container is increased free egress of the solution from the tubes can be secured The gross characteristics of the lochia change rapidly so that within 4 or 5 days it is a scanty thin transparent secretion free from odor With this change there is usually general systemic improvement due to the diminution of septic and toxic process

Bacteriological examinations of lochia and retained contents should be made at each dressing They will be of great assistance when studied in conjunction with clinical evidence in deciding when the infection is under control

Bacteria appear very abundantly in the fetal puerperium after 4 to 36 hours and the cocci are usually the last bacteria to disappear

CONCLUSIONS

1 Irrigation of the uterus with 5 solution of sodium hypochlorite of low alkalinity in combination with hypertonic saline solution destroys bacteria and dissolves blood clot placental tissue and debris without destroying living tissues and leucocytes

If started early this treatment may arrest local infection and prevent extension to adnexa and blood stream

3 Septic endometritis puerperal or postabortion has been cured by the intermittent irrigation of the uterus with sodium hypochlorite solution

4 Repeated bacteriological examinations which are recorded on bacteriological charts are contributory evidence of the state of the infectious process

5 This method of treatment should be used only in well equipped hospitals by skilled operators because special technique and armamentarium is necessary and keen judgment is required in the selection of cases Moreover ill advised or carelessly performed attempts at such treatment will cause traumatic extension of the uterine infection

6 The treatment is most useful in the so called putrid or shaggy puerperal septic endometritis of mixed bacterial origin with marked subinvolution of the uterus If extension to the parametrium has occurred or is suspected attempts at the treatment should not be undertaken

REFERENCES

- C v J R C S m g g t t h t c t m t f  
p e p l p B t M J L o d o 4 3 6-3 8  
C i s v n \ D t r a t m t d l f t t e p t  
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d D k P d p 4  
D L J B S l r d y b t t p r o b l m \ m  
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## ARE PICRIC ACID AND MERCUROCHROME SOLUTIONS LOCALLY ANÆSTHETIC?

By DAVID I. MACHT, M.D., LI. B., BALTIMORE, MARYLAND  
D oct f th D p m t f Ph m l g s J h H pk U ty S h l f M d c

PICRIC acid and oxymercuridibromfluorescein have been used considerably in the surgical treatment of burns the former having been employed for a longer time than the latter. Solutions of these two drugs are highly colored and stain the skin. Picric acid solutions of 0.5 per cent or stronger have been painted over or applied as in dressings over burnt surfaces and according to some authors have been found to be exceedingly efficacious. Thus Hare in his *Practical Therapeutics* states:

It has been found exceedingly efficacious in solution in the treatment of severe burns and scalds. The same author also speaks of 5 per cent solutions of picric acid as being antiseptic so that it may be used to disinfect the skin. It is well known however that this chemical when absorbed into the system will produce renal irritation and other signs of poisoning so that its use over extensive areas and in cases of deep burns is contra-indicated as absorption might occur and lead to poisoning.

In the last few years various surgeons have been employing solutions of oxymercuridibromfluorescein or mercurochrome 220 soluble not only as an antiseptic but also as a dressing for burns of the first and second degree. Application of this drug has been claimed to be beneficial not only by virtue of its powerful antiseptic properties but also as a relief to the pain following burns and scalds. Mercurochrome poisoning by absorption from the skin has never been reported and in general the toxicity of this drug is much less than that of picric acid (7). In connection with these uses of picric acid and Mercurochrome 220 soluble the author deemed it desirable to inquire into the mechanism of their sedative effect on burns and scalds and more particularly to ascertain whether these solutions exhibit any locally anæsthetic properties on the nerve endings of the affected areas.

The methods employed in this experimental study were the well known classical procedures for determining and analyzing the local anæsthetic effects of drugs. Three methods were tried in the present study. In the first series of experiments the local anæsthetic effects of the drugs were studied on the sensitivity of the rabbit's cornea. The reflexes following the touch

ing of the cornea before and after instillation of the solution into the conjunctival sac were studied. By this method no evidence of local anæsthesia was obtained after instillation of either dilute picric acid or mercurochrome solutions. In this connection it was found that picric acid by virtue of its acidity was much more irritating to the eyes than mercurochrome solutions. Indeed mercurochrome has been employed successfully in ophthalmological practice by Clapp and Martin (2), Burnett and Gaus (4), Gräde (3), Boeckmann (1) and others.

In a second series of experiments the anæsthetic properties of the solutions were tested by the frog skin method. As is well known to all physiologists and pharmacologists this method is practiced as follows. The brain of a healthy frog is pithed but its spinal cord is left intact. The frog is then suspended and each leg is dipped into a weak solution of acid. The irritation of the acid on the sensory nerve endings of the skin produces a reflex retraction of the limb from the beaker containing the acid solution. The skin is then washed off by dipping several times in fresh water. The same limb is then immersed for a definite number of minutes into the solution to be tested and after the given exposure to the unknown solution its response to irritation by the acid is again determined. In this way it can easily be determined whether or not a local anæsthetic effect has been produced. Such a local anæsthetic effect is due practically entirely to a local action on the skin there being very little absorption into the general circulation in the short time through which the experiment is performed. The author has repeatedly tested solutions of picric acid and mercurochrome 20 soluble for their local anæsthetic effects according to this method and in no instance was any local anæsthesia produced by the drugs even after an exposure of 15 minutes.

The third method of investigation was the study of the effects of the solutions on the conductivity of sensory and motor nerve fibers according to the well known pharmacodynamic methods described in treatises on experimental pharmacology. The experiments performed were made on the sciatic nerves of cats and dogs. After the exposure of the nerve and the cleaning of its



sheath a pledget of cotton soaked in a given solution is applied to the nerve trunk for various periods of time. A blood pressure and respiratory tracing is recorded on a kymograph and the effects of electrical stimulation of various intensities applied above and below the block are studied on the blood pressure and the respiratory curves on the one hand and on the contraction of leg muscles on the other hand. In this way when a typical local anæsthetic such as cocaine is applied to a nerve pharmacologists have found that the conductivity of the sensory nerve fibers is paralyzed long before that of the motor nerve fibers but that after application of strong solutions of the local anæsthetic for prolonged periods of time the motor fibers are also finally depressed or completely paralyzed. The author studied the effect of application of solutions of picric acid and mercurochrome to nerve trunks in this way and found that they produced absolutely no effect on the conductivity of either sensory or motor nerve trunks.

It is therefore evident that neither picric acid nor mercurochrome employed in the treatment of burns possesses what may be called true local anæsthetic properties. Their sedative effects in cases of burns must be explained other ways. It is possible that the acid solutions of picric acid produce protein precipitates which act somewhat as protectives. On the other hand the acid properties of trinitrophenol are not conducive to the relief of pain. The action of mercurochrome solutions in burns must be explained in other ways. This drug does not precipitate proteins and therefore cannot be said to form a protective layer of an albuminate on burns. It is possible that it may form some other loose combination with body juices. Its sedative effect must also in a measure be due to its slightly alkaline reaction. It is known clinically and has also been proved experimentally that alkalis are much less irritant to the tissues than are acid solutions.

The author also carried out another series of experiments relative to the combination of the solutions of the two drugs with a local anæsthetic. As was shown some years ago benzyl alcohol or

phenmethylol possesses powerful local anæsthetic properties (5). Two and 3 per cent solutions of this drug can be and have been employed as local anæsthetics in surgery (6). In addition to their local anæsthetic properties such solutions are also mildly antiseptic (8) and it has been shown by the author that benzyl alcohol has very low toxicity indeed. The author also experimented with mixtures of picric acid with phenmethylol on the one hand and mercurochrome solutions and phenmethylol on the other hand. By incorporating 1 or 2 per cent of phenmethylol in such solutions it was found that they become distinctly anæsthetic on local application as determined by the methods already described. It is therefore suggested that the addition of phenmethylol to these solutions may serve a useful purpose.

#### SUMMARY

1 Solutions of picric acid and oxymercurochrome (mercurochrome 220 soluble) were tested in regard to their local anæsthetic properties by a well known pharmacological method and were found to be not locally anæsthetic.

2 The sedative effects of mercurochrome and picric acid solutions in the treatment of burns and scalds must therefore be explained in other ways.

3 By incorporating 1 or 2 per cent of phenmethylol or benzyl alcohol with these drugs such solutions can be rendered locally anæsthetic and may therefore become more useful for clinical purposes.

#### BIBLIOGRAPHY

- Boeck, N. E. W. R. M. t. M. d. 94
- Cl. F. C. A. and M. R. T. N. M. G. J. Am. M. A.
- 3 C. A. D. H. V. S. III. M. J. O. ix. 44
- 4 L. S. T. E. R. W. B. B. U. R. T. I. L. d. G. U. S. L. H.
- 5 M. C. H. T. D. I. J. Ph. m. c. l. & L. v. p. Th. p. 98
- 6 Id. m. J. Ph. m. l. & E. p. e. r. Th. ap. 99
- 7 M. C. T. D. I. d. H. A. R. W. C. J. Ph. m. l. &
- 8 M. C. I. T. S. C. A. R. T. Z. d. S. T. A. N. I. J. U. o. l. 9. 1. 347

# EDITORIALS

## SURGERY, GYNECOLOGY AND OBSTETRICS

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JULY 1928

### ASPIRATION VERSUS EMBOLISM IN POSTOPERATIVE PNEUMONIA AND PULMONARY ABSCESS

IN addition to the massive and usually fatal embolus caused by the separation and mobilization of a large fragment of a thrombus occupying some such large vein as the femoral or the iliac (gross embolism) there is a second form of embolism, of more frequent occurrence which may give rise to symptoms simulating pneumonia or lead to pulmonary abscess. This condition (minor embolism) was lucidly described by Conner in cases of typhoid fever and later in other cases of apparently healthy persons. Its significance as a postoperative complication was suggested in 1900 by Mikulicz. It is extremely difficult to differentiate at the necropsy table between areas of pneumonia arising on the basis of an infarct and those resulting independently or from aspiration and of late years Cutler and others, following Mikulicz's suggestion have come to the conclusion that the large majority of the postoperative pulmonary complications formerly considered to be due to the anæsthetic and infection of the

lung through the respiratory tract are actually embolic in origin. Cutler arrived at this point of view as a result of an extensive clinical study supplemented by experiments in which he and his associates were unsuccessful in dogs as others had been in producing pulmonary infection by the aspiration route while succeeding with infected emboli.

Fetterolf and Fox and more recently Schluter and Weidlein and Holman Chandler and Cooley have contributed further experimental evidence that infected emboli may be responsible for the development of pneumonia and pulmonary abscess.

As a result of the studies quoted there is a growing conviction that the adherents of the embolic theory of postoperative pneumonia and abscess have the best of the argument and yet there is reason for hesitation before accepting their conclusions. The results obtained in the experiments cited were by no means uniform and apparently even a virulently infected embolus may produce in an otherwise healthy lung nothing more than a mild inflammation all signs of which rapidly disappear. In actual practice especially in virtually aseptic operative fields it is somewhat difficult to imagine the occurrence of virulently infected emboli. Furthermore, as Conner found in his study of pulmonary infarction in typhoid fever pleural pain and hæmoptysis while not constant are common symptoms in embolic disease while in acute postoperative pulmonary complications particularly those that start during the first two or three days after operation as most of them do pleural pain and hæmoptysis are noticeably lacking.

Cutler and Schlueter compiled from the literature 1908 cases of pulmonary abscess of which 30 per cent were postoperative. They did not attempt to explain the remaining 70 per cent but apparently regarded abscess following pneumonia or bronchiectasis as essentially different from abscess developing after an operation. Smith takes exception to this. There is no material difference in the bacteriology of 56 cases from the literature in which the predisposing cause was known and in which bacteriological and pathological studies had been made. Ten of these were postoperative and 46 spontaneous post bronchiectatic post pneumonic and so forth. In all lesions two or more of the following organisms were found: *spirochetes*, fusiform bacilli, cocci and vibrios as a sortment that frequently occurs in tonsillar crypts and around the teeth. These data Smith regarded as offering strong presumptive evidence that the oral cavity was the usual source of infection in both non operative and postoperative pulmonary abscess and he therefore attempted to produce pulmonary abscess in mice, guinea pigs, rabbits and dogs by intratracheal inoculations of bloody material obtained from about the teeth of patients with pyorrhea. He anesthetized the animals with ether and introduced the material into the trachea so that it trickled down into the lungs, a technique designed to simulate the circumstance under which an anesthetized patient aspirates material from the mouth. By this procedure he succeeded in producing aspirative pneumonia and abscess where others had failed. Fifty per cent of his animals died of pneumonia and 60 per cent developed pulmonary abscess. The three dogs pre-entitled no pulmonary lesions. The absence of effect in these and in the animals that remained well he explains by natural resistance by a difference in dog age or by an active cough reflex.

In view of the results of Smith's recent experiments it would seem somewhat hasty to accept the rather radical suggestion of the exponents of the embolic theory that all effort to limit the frequency of postoperative pulmonary complications be directed to improvement of surgical technique.

RUSSELL M. WILDER

## POSTOPERATIVE SURGICAL INTERVENTION

CONSIDERABLE stamina is required to initiate and carry out postoperative surgical procedures. Possibly this is because of a fear of reflection on the surgical skill exercised primarily or because a second or even a third operation to relieve a complication is often blamed for what may have been an inevitably unfavorable termination. Clinical and surgical judgment are often taxed to the utmost in these emergencies. Too often the decision to intervene surgically is delayed beyond the time of greatest safety and possible benefit to the patient.

C. H. Mayo, referring to exploratory incision as a primary operation, often states that he has seen no harm come from early incision when the clinical details are obscure but that many times the mortality is high or the benefit small if operation is delayed until the condition is self-evident. The same dictum may be applied to postoperative procedures and is a great comfort in times of stress.

Bleeding and dyspnea following thoracotomy may endanger the patient. Pressure from blood clot, bilateral or even unilateral recurrent laryngeal nerve injury with cord paralysis and rarely collapse of the trachea are the usual obstructive factors. Prompt opening of the wound, turning out of clots, catching bleeding vessels or performing tracheostomy are life-saving measures. This usually

results in wound infection and probable subsequent tissue distortion but this is a minor incident

Following gastric surgery there is often a fertile field for what Bartlett has called clinical clairvoyance. Indeed the cause of the trouble may not be clear after exploration.

When prompt frequent and intelligent lavage demonstrates that the stomach is not emptying, not too much delay should be engaged with the blood chloride balance, intravenous glucose and rectal nutrients. Freeing of a distal jejunal limb twisted or folded in fresh plastic adhesions, enterointerostomy between the proximal and distal loops of the jejunum or jejunostomy for drainage and feeding purposes are efforts that are richly rewarded if opportune.

The convalescence often unduly prolonged following pleural drainage may be shortened or a fatal termination avoided by alert judicious surgery. Retention of pus is usually the cause of the fixed or increasing debility. Enlarging the opening, placing it lower to drain the most dependent point in the abscess or raising it to a higher level if contraction or formation of granulation tissue has raised the floor of the cavity are valuable measures. It is never amiss to consider the possibility of the presence of incarcerated drainage tubes or gauze packing.

Surgery of the biliary tract sometimes presents the postoperative problems of bleeding, common duct stenosis, or escape of bile into the abdominal cavity. Probably there is more reluctance in re-opening this field than any other. Bleeding from the cystic artery may be quickly fatal and that from the liver notch very alarming. Persistent or promptly appearing jaundice brings up a host of speculations, none of them pleasant. Bile produces a low

grade peritoneal irritation and stupefying reaction that is sometimes difficult to analyze. Timely skillful secondary surgery is a great beneficence in this field.

Appendicitis, strangulated hernias and intestinal resections all carry potential postoperative difficulties in which reasonably prompt action may be the patient's only salvation. Stagnation or reversal of the fecal current from an ileus, peritonitis or frank obstruction usually accounts for the picture presented. Jejunostomy is not always successful under these circumstances but it often results brilliantly in a seemingly hopeless situation and its performance adds very little to the patient's crushing load.

McVicker, Crile, Walters and others have introduced valuable measures preparatory to operation that obviate many postoperative complications. Many things can be carried out during an operation that are likewise efficient. Exploration for possible unexpected pathological conditions with exposure and isolation of the involved area with packs that also protect adjacent tissues from injury or contamination is good prophylaxis. Certain hemostasis, careful dissection, the clamping and cutting of important structures well isolated under vision helps to avoid subsequent trouble. Placing a tube in the jejunum or ileum when peritonitis, ileus or temporary bowel obstruction are imminent should always be considered. Few patients are so desperately ill that necessary haste makes the application of these principles impossible.

Continuous consideration, balanced judgment and real stamina are called upon not only to avoid unnecessary postoperative intervention but also to initiate action while there is reasonable safety and chance for relief.

PAUL A. WHITE

# MASTER SURGEONS OF AMERICA

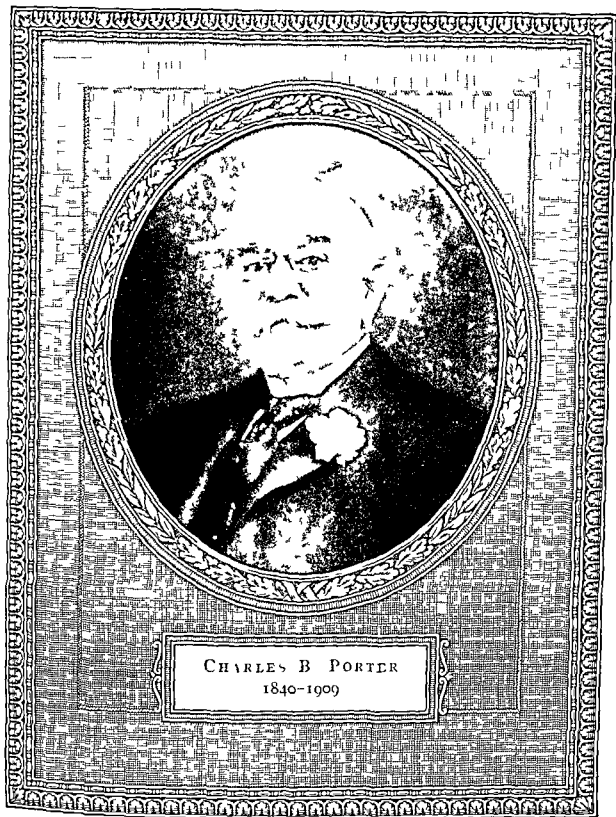
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## CHARLES BURNAM PORTER

CHARLES BURNAM PORTER was born in Rutland Vermont January 19 1840 and died in Boston May 21 1909. He came from good old English stock. His original American ancestor Daniel Porter came to this country about 1650 and settled near Farmington Connecticut. He was a surgeon and bone setter of note.

The story of the Porter family is that of one of the most remarkable medical families in America and it is doubtful if it could be duplicated. Apparently the male descendants of Daniel Porter throughout seven generations in this country were all doctors. Charles Burnam Porter the subject of this sketch was the seventh physician in his family in direct descent. There have been altogether eighteen physicians of this name of whom there is a record. The son of Dr. Porter Dr. C. A. Porter is a prominent surgeon practicing in Boston at the present time. He too has a son contemplating the study of medicine. All of the members of the family lived active lives in western Connecticut Massachusetts and Vermont. Several of them attained considerable reputation as surgeons and bone setters. James Porter the great grandfather of Charles Burnam Porter was a Vermont Tory. He received a commission as surgeon under the British flag and served in Howe's Army of invasion on Long Island.

Charles Burnam Porter grew up a vigorous out of doors lad in Vermont. At the age of eighteen he entered Harvard University and was graduated with the A. B. degree in 1862. He at once began to study medicine in the old North Grove Street School and passed from there to the Massachusetts General Hospital where he served as interne in 1864. He was graduated in medicine from Harvard Medical School in 1865 during the Civil War. He immediately went to Washington looking for Army Service and by dint of great perseverance succeeded in obtaining an appointment on the staff of one of the principal military hospitals where he served with great credit until the end of the War. Within a short time after receiving his appointment he was placed in charge of one of the large surgical wards. It is a matter of record that he had at one time as many as seventy four cases of compound fracture under his care which in those days of septic wound meant a deal of dressing and personal attention.





In June 1865 he was married to Miss Harriet A. Allen of Cambridge. At the close of the War he returned to Boston. Three years later he went abroad with his wife and two children studying for nearly two years in Vienna, Berlin and Paris. Returning to Boston he received important professional appointments in rapid succession—physician to Out Patients, Massachusetts General Hospital in 1866, district physician in 1866, physician to the Boston Dispensary in 1867, assistant demonstrator of anatomy, Harvard in 1867, demonstrator of anatomy under Oliver Wendell Holmes in 1868, visiting surgeon to the Massachusetts General Hospital in 1875, instructor in surgery under Henry J. Bigelow in 1879, assistant professor of surgery in 1880, professor of clinical surgery in 1887, which position he held until 1903, when by reason of the age limit he automatically retired.

Dr. Porter had taught medical students continuously for 37 years, a record almost equal to that of Henry J. Bigelow's 40 years in the same institution. As a result of his work through those 37 years he came to be regarded as one of the soundest clinical surgeons and one of the best teachers in New England, a man of singular simplicity of life, rarely given to speech in public or the writing of professional papers. The arts of the medical politician were foreign to his make-up, and his steady advancement in Harvard and the Massachusetts General Hospital were through merit alone. While his appointments at the Harvard Medical School and the Massachusetts General Hospital were purely surgical in character, he always combined general practice with surgery, and had for many years a large private practice in addition to his hospital and medical school work.

His contributions to medical literature were not voluminous, consisting chiefly of papers read before medical societies and publications in medical journals on a wide variety of subjects in which at the time he was particularly interested. Perhaps his special interest lay in the line of plastic surgery, in which he excelled. No one of his numerous assistants or students can look back upon his service with Dr. Porter without recollecting with great pleasure and satisfaction the manual dexterity, technical skill and surgical judgment which he constantly exhibited in all of his work. It was a real joy to watch the neatness and exactness and dispatch which always characterized his work. His flaps always fitted perfectly; he never had to trim them. In typical operations of all kinds he was a past master. His work was made more efficient undoubtedly by his long anatomical training and familiarity with the teaching of operative surgery.

An outstanding characteristic of Dr. Porter's work was the uniform kindness and consideration which he always showed to his patients and to his staff as well, a quality of heart which greatly endeared him to all those who served under him, in fact to everyone associated with him in any capacity. There

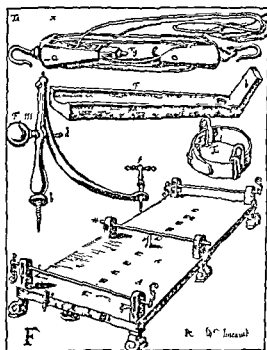
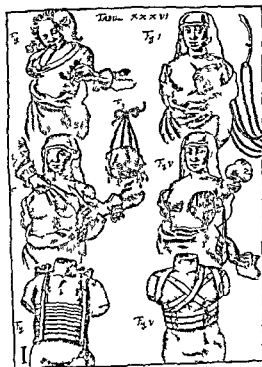


linger still in the memory of those who so greatly profited by his professional counsel and personal kindness grateful recollections of the great privilege and benefit they obtained through association with him

The qualities of head and heart here so inadequately set forth the long years crowded full of fruitful service to his fellow men as teacher and practitioner of surgery his contributions to the science of surgery and his extraordinary proficiency in the practice of its art all entitle Charles Burnam Porter to an honored place among the master surgeons of this country

J M T FINNEY





# THE SURGEON'S LIBRARY

## OLD MASTERPIECES IN SURGERY

ALFRED BROWN, M.D., F.A.C.S. OMAHA, NEBRASKA

### THE SURGICAL ARMAMENTARIUM OF JOHANNUS SCULTETUS

**A** REVIEW of the surgical books of the sixteenth century shows that the major portion of the literature of that period on the subject is wholly of the description of clinical cases, more or less iteration of details with practically no attempt made to draw conclusions from them which might establish either a surgical pathology which would prove acceptable or a therapeutic method which would stand the test of continued application. At first blush this fact appears remarkable and almost unbelievable that a number of men such as these were—capable of clear headed observation and with such an enormous mass of clinical material at hand on which to employ this observation—should be content with the mere description of individual cases and then let the matter rest. For the explanation of this fact one must turn from surgery and look into the condition of its sister science—internal medicine.

The seventeenth century was the era of the introduction of the systematists in medicine. As Paracelsus had been the most prominent medical bolshevist of the sixteenth century, it was natural that some of his peculiar ideas—especially those which had to do with the supernatural and mystic—should be revamped and brought forward as a system to explain the ills that flesh is heir to. The humeral theories of Hippocrates and Galen were no longer tenable so adopting nearly all that was bad in Paracelsus such as his weapon salve and sympathetic powder his followers harked back to the Hermetic books and Cabala and aligned themselves with the Zoroastrian doctrines. The doctrines of Paracelsus had a good deal of chemistry of a sort in them and were later to serve as the stepping stone to a more sane chemical idea but before this came about there was an intermediate phase in which these pantheistic ideas were amalgamated into a system of mysticism and piety founded upon a chemical basis by Van Helmont who was a chemist a vacillating doubter of all fact and finally a theosophist. The keystone of the system was that the fundamental basis upon which the body depended for its existence was the Archeus and anything wrong with the body was due to a change in it.

Following Van Helmont came the Iatrochemical (Healing Chemical) system of Sylvius which was based upon chemistry as developed from alchemy and proved to be the infant beginning of modern chem-

istry. Though being unwilling to relinquish entirely the idea of a fundamental spiritus and innate heat of the heart nevertheless the circulation of the blood and action of the lymph and chyle was recognized and a system built upon these in an attempt to harmonize the old theories and newer facts. The fundamental basis of general pathology was that health was due to a process of fermentation in the body without either an acid or alkaline salt—a condition of perfect neutrality. Let either one acid or alkali become predominant and disease appeared.

As opponents of the iatrochemists came forth the iatromechanical school which founded its ideas on the solid portions of the body which they weighed and measured calculating from the mathematical results the various errors of the body in disease. Respiration was based on the mechanics of the thorax digestion on trituration of food and so on through the functions of the body. The basic idea was that health was determined by a smooth and even carrying on of mechanical and physical functions.

With these various unproven and in many instances far fetched ideas serving as bones of contention to be fought over by the medical men the surgeons realized that they in their field were dealing with facts and had better let others theorize as they wished. Consequently they held themselves to this line and contented themselves with describing and publishing surgical conditions as they observed them. Surgical technique was however improving and its tools were multiplying by leaps and bounds. It was therefore natural that an attempt should be made to standardize this part of surgery as Dalla Croce had done nearly a century previously.

This task was attempted by Johann Schultes better known as Scultetus the city physician of Ulm who published the fruits of his labors in a book called *The Armamentarium of Surgery* in 1653. The volume is of particular interest because of the beautiful and numerous illustrations which show not only the instruments themselves but also the technique of many surgical procedures. The Scamnum Hippocrates or fracture table is shown in the lower right illustration and the beginning of a Cesarean section in the upper.

The armamentarium is followed by the usual century of observations—a record of a hundred cases of more or less surgical interest but the popularity of the book which went through many editions was determined by its value for technical purposes.

## REVIEWS OF NEW BOOKS ON GYNECOLOGY AND OBSTETRICS

B I L L I E F D L B S M D F A C S O M A H A N E B R S K A

WE are indebted to Herbert R. Spencer for a historical sketch of *British Midwifery*, embracing the period of 650 to 1800. In the introduction we are given the story of the Chamberlains and the midwifery for eons. In successive chapters the author presents sketches of the lives of such men as William Harvey, John Maubray, Sir Fielding Ould, William Smellie, John Harvey, William Hunter, Charles White, William Osborn, and Thomas Denman.

These biographic sketches are accompanied by excellent photographs of the founders of British midwifery. In chapter II we have a history of the lampoons and attributes assigned to the midwife. Chapter III presents a historical sketch of the puerperal fever and chapter IV gives a brief review of the contributions of British obstetricians to the beginning of the nineteenth century.

The story is well told and will be appreciated by all who are interested in the development of the obstetric art.

ANNOFL statue of the admirable work of Banister and his associates in the historical sketch of Queen Charlotte's Maternity Hospital founded in 1799 and reputed to be the best lying-in hospital in Great Britain. The sketch is embellished by a portrait of Charlotte, Queen of Great Britain, a view of the original Mary and How's end of the first Queen Charlotte Hospital.

This book on *The Practice of Obstetrics* is credited to its members of the hospital staff and may be said to have fairly achieved the impossible in that it is remarkably well adapted to both the needs of student and practitioner of midwifery. Its scope is well within the range of the medical student and yet it presents in detail the various subjects and in a manner that cannot fail to meet the practical everyday needs of the general practitioner.

The chapter on *hemorrhages in the puerperal period* is a masterpiece and reflects the high collective attitude of the authors. It may not be anis to remark that not all readers will agree with the author's in the management of the septate uterus. The following quotation is the one nearest.

After the uterus has been emptied of the rubbing of the tube which should be placed in the active hinging the top of the fundus and stretched to the cervix by couple of catgut sutures. By means of the tube which should be long enough to

be strapped conveniently to the thigh irrigations of the uterus are made at two hourly intervals during the day and four hourly during the night. For their purpose Milton's fluid to per cent of eusol or glyceric acid colored by the addition of a mixture of 10 line is used. A glass syringe holding 4 ounces is used. Irrigation and drainage of the acutely septic uterus is the surest and quickest means of clearing up the infection and preventing the extension of the local infection into the blood stream.

In referring to the prognosis and effects of treatment in eclampsia the authors frankly admit of difficulties. An apparent improvement may be followed by deterioration and a patient deeply ill with repeated convulsions may as promptly change for the better. The results of treatment say the author are most difficult to estimate. It requires a very large number of cases to justify any conclusions so capricious as the disease. When as often happens recovery is slow and dramatic the remedy hate it may be assigned credit for the cure. Thus we find that immediate delivery by vaginal or abdominal caesarean section regarded by some as the only method while others regard all operative delivery as a source of danger and put the trust in various forms of medical treatment. The authors observe that the mortality tends to rise in proportion to the amount of obstetric interference.

The three subjects of obstetrics presented in a logical and ordered manner the illustrations have gone to a fine blue. The review recommends the book as a text for our medical schools and as a reference book of the shelves of our practicing profession.

PROFESSOR G. Winter of Königsberg presents a monograph on operative obstetrics for practitioners and students. The work may be said to be the epitome of the twenty-five years of experience in the teaching of operative obstetrics. We find the subject presented in a manner that reflects the art of the teacher. We note that the author has incorporated his contribution to the *Halbmonatliche Beiträge und Praktische Beiträge* on *Diagnose und Behandlung der mütterlichen Verletzungen* and *Die Behandlung des Abortus* in a chapter by Benthin on *Uterus and Appendages*. The book is put together in a chapter contributed by Vojak on *Diagnose und Behandlung der kindlichen Verletzungen* and a second chapter on *Die Behandlung der kindlichen Asphyxie*.

L. P. B. P. Lessa D. C. W. B. I. A. T. T. C. S. d. S. B. be

T. H. f. B. P. M. W. 6. S. O. T. F.  
P. K. I. y. H. b. d. l. d. b. e. l. C. I. C. I. P. H. I. a.  
f. L. o. I. So. & D. I. so. L. d. M. D. B. S. (L. J.) L. o. d.  
f. H. B. I. O. O. cs. Ry. J. H. B. B. M. D. F. A. C. S.  
A. I. C. W. B. O. M. B. F. R. C. S. L. I. D. M. I. F. R. C. S.  
L. C. K. M. D. F. R. C. S. L. C. P. H. I. C. S. M. F. R. C. S.  
L. a. R. b. e. M. S. F. R. C. S. A. I. K. W. I. m. I. o. o. J. & C. m. p.

The pages are not burdened with introductory chapters on the preparation of the patient, operating room and materials for operation, anesthesia and kindred subjects. In the opening chapters he proceeds at once with the subject in hand. It is apparent that the author is endeavoring to pass on to his readers the wealth of clinical experience which he has acquired in his years of clinical instruction and in this we believe that he has succeeded most admirably.

To emphasize the dangers of interference in the process of labor the author finds a mortality of 0.1 per cent in natural labors as against 0.3 per cent in forceps cases, 0.4 per cent in extractions, 2.1 per cent in cesarean sections, 0.1 per cent in manual removal of the placenta and 0.5 per cent in craniotomies. Winter records 80 cases in which the placenta was delivered manually with 18 deaths, three of the number died from rupture of the uterus, one each from nephritis, embolism and eclampsia, from hemorrhage and 3 from infection.

In the presence of tuberculosis of the lungs the author would interrupt the pregnancy in all cases of active tuberculosis prior to the end of the seventh month of gestation. After the seventh month he would reserve interference for only the early cases and for those in which the operation is performed solely in the interest of the child.

Valvular disease of the heart without loss of compensation is not an indication for the interruption of pregnancy with the possible exception of mitral stenosis. When however the heart lesion is associated with a chronic nephritis or with tuberculosis which is either acute or chronic there exists a positive indication for the interruption of pregnancy.

Keinen Abort zu viel und Keinen zu wenig — no fetus shall be sacrificed unnecessarily and no mother's life shall be imperiled or her health ruined for want of the destruction of the unborn fetus.

The illustrations are abundant and splendidly executed. Such operative procedures as the vaginal cesarean section, the application of the forceps version and extraction, craniotomy, embryotomy and abdominal cesarean section are graphically illustrated in the several stages of the procedures. The chapter on injuries to the newborn is unique and instructive. In it are many suggestions which are of great value in the care and management of these lesions.

THIS little work of Comyns Berkeley and George M. Dupuy<sup>1</sup> is unique in that it is in no sense a text on the subject but rather a well ordered collection of illustrations accompanied by descriptive legends. Thus the anatomy and physiology, growth of the fetus, pregnancy and labor and finally the treatment of the patient and her child after birth are presented in a logical order in the

form of pen drawings together with a condensed and lucid descriptive legend. There is much merit in this work of 150 pages.

THE admirable work of Heuser<sup>2</sup> presents the subject of radiology in gynecology, obstetrics and urology not as a substitute but rather as a valuable adjunct of the clinical examination and as a collaborating agent. In the field of gynecology the limitations of air injections alone are discussed and the advantages of the employment of lipiodol iodopon and similar media used in conjunction with insufflation are presented. The author advocates the utilization of lipiodol diluted to 50 per cent consistency with sterile olive oil this affording a medium less viscous and one that requires less pressure in its introduction. To obliterate the distracting shadows of fecal material and gas in the large bowel the author gives a cathartic the day before, an enema of salt solution one hour before the examination and then injects one and one half liters of a similar solution just before the examination. The bladder is injected to the point of moderate distention with air.

In the gravid or suspected gravid uterus lipiodol should be used only when an actual doubt exists as to the condition and a clarity of information is necessary. The author states that so far he has seen no abortions when adequate precautions are observed. Until the fetal parts and membranes completely block the uterine canal the patency of the tubes can be demonstrated. In advanced pregnancy the lipiodol will not advance beyond the cervix.

The author opines that insufflation of the tubes can only demonstrate patency and it remains for lipiodol and similar media to provide the information as to caliber, position and integrity of the tubes.

It is claimed that the fetal parts can be visualized as early as 3 1/2 months but the author recognizes the difficulties of the employment of radiography in obstetric cases.

The author indulges in much detail in the utilization of lipiodol in the visualization of the urinary bladder, kidney and ureters.

The monograph is richly illustrated with skiagrams. All in all this work of Heuser is very attractive and instructive.

THE recently published work of Crossen on *Gynecology for Nurses*<sup>3</sup> is a most attractive production. It is beautifully illustrated and contains a wealth of information suited to the needs of the nurse. After a brief presentation of pelvic anatomy and physiology the author proceeds with a recital of many of the gynecological diseases and in this chapter the author has restrained himself from indulging in too much detail.

A. ATLAS & MIDWIFERY BY C. M. Y. B. L. L. Y. M. A. M. C. M. D.  
(Ca. tab.) F. R. C. P. (Lo. d.) M. R. C. S. (E. & J.) Geo. G. M. D. P. Y.  
M. D. Lo. d. d. N. W. Y. K. W. L. M. W. O. O. D. J. C. 96

L. R. C. I. E. GYN. E. LOGIE O. E. T. Q. U. E. T. E. U. LOGIE  
BY D. M. D. C. I. N. H. C. B. O. S. A. C. S. 96  
GYN. COLOG. F. N. U. S. E. S. BY H. Y. S. T. G. C. O. S. M. D.  
F. A. C. S. S. T. L. O. S. T. H. C. A. M. O. S. B. Y. C. M. P. Y. 97

The chapters on treatment both non operative and operative are profusely illustrated and given to much valuable detail as are also the chapters on preparations for gynecological examinations preparations of supplies for operations and preparation of patient

The reviewer makes bold to suggest that in subsequent editions of the work we may be favored with a presentation of such subjects as amenorrhœa hæmorrhage leucorrhœa sterility and backache—their causes and the means employed by the nurse in their control

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# CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

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## PRELIMINARY PROGRAM FOR BOSTON CLINICAL CONGRESS

THE surgeons of Boston are planning a highly attractive program of clinics and demonstrations for the eighteenth annual Clinical Congress of the American College of Surgeons to be held in that city October 8-11. A preliminary program of the clinics and demonstrations is presented in the following pages. This program is to be revised and amplified during the weeks preceding the Congress so that the final program will completely represent the clinical activities of that great medical center in all departments of surgery. Clinics will begin at 2 o'clock on Monday afternoon and continue through the mornings and afternoons of the following days.

General headquarters for the Congress will be established at the Statler Hotel where the ball room, foyer and other large rooms on the mezzanine floor have been reserved for registration and ticket bureaus, bulletin boards, exhibits, executive offices, etc. The ballroom at the Copley Plaza Hotel will be utilized for the evening meetings, hospital conferences and other large gatherings.

The annual hospital conference opens on Monday morning in the ballroom of the Copley Plaza Hotel. An interesting program of papers, round table conferences and practical demonstrations dealing with the many problems related to hospital efficiency is being prepared and will be published at an early date. A feature of the hospital conference will be a special session on Wednesday

afternoon devoted to a symposium dealing with the standardization of the ophthalmological and otolaryngological departments in general hospitals. The conference is planned to interest surgeons, hospital trustees, executives and personnel generally, and an invitation is extended to all persons interested in the hospital field to attend the conference.

An interesting feature of this year's session will be a showing of the surgical films that have been produced under the supervision of and approved by the American College of Surgeons. A number of these films have already been completed and others are now in course of preparation and will be ready for their premier showing in Boston.

An application for reduced railway fares on account of the Boston session is pending, and we are assured that a rate of one and one half the ordinary first class one way fare will be in effect from all points in the United States and Canada.

### EVENING MEETINGS

The Executive Committee of the Congress is preparing programs for a series of evening sessions. The Presidential meeting on Monday evening will be held in Symphony Hall. At this the first formal session of the Congress the president elect, Dr. Franklin H. Martin of Chicago, will be inaugurated and deliver the annual address. On the same evening Professor Vittorio Putti, professor





## PRELIMINARY CLINICAL PROGRAM

## GENERAL SURGERY GYNECOLOGY OBSTETRICS UROLOGY ORTHOPEDICS

## MASSACHUSETTS GENERAL HOSPITAL

## Monday

- Orthopedic service— Dry clinic  
 NATHANIEL ALLISON Tuberculosis of the knee  
 P D WILSON Tuberculosis of the spine  
 DR M V SMITH PETERSEN Tuberculosis of the foot  
 R K GHORMLEY Internal derangement of the knee joint  
 NATHANIEL ALLISON and DR KELLY Congenital dislocation of hip  
 Surgical service—2 Dry clinic  
 J H MEANS E I RICHARDSON and E C RICHMOND The thyroid  
 GEORGE McIVER Burn  
 DRS WHITE and SPRAGUE The heart in surgery  
 C M JONES The gall bladder  
 J H MEANS Surgical cases

## Tuesday

- J D BARNEY and staff— Genito-urinary operation  
 Surgical service—11 Surgical operation  
 D F JONES— Dry clinic Cancer of the gastrointestinal tract  
 C A PORTER—2 X-ray burn  
 W J MINTER J B AYER and J S HODGSON— Surgery of the nervous system operations and demonstration of cases  
 J A MEIGS—2 Uterine bleeding etc  
 L S MCKINTICK—2 Radium in cancer of the rectum  
 ARTHUR ALLEN and R H SMITHWICK— Circulatory diseases of the extremities postoperative pulmonary infections

## Wednesday

- DRS WYMAN WHITTEMORE CHURCHILL and LORD—9 Thoracic surgery operations  
 R C CABOT and MISS CANNON—2 Social service  
 DR BREWSTER—2 Surgical clinic  
 DR LLOYD and associates— Syphilis and surgery  
 F A WASHBURN—2 Early day of the Massachusetts General Hospital first ether anesthesia  
 DR SIMMONS— Surgical cases  
 WILLIAM HERMAN— Psychiatry and surgery  
 DR HOLMES and associates—2 Demonstration in X-ray department

## Thursday

- Orthopedic service—9 Operations and demonstration of cases  
 DRS WILSON and DANFORTH Arthritis of the spine  
 NATHANIEL ALLISON and DR COONSE Arthritis of the knee  
 WILLIAM ROGERS and DR STRAUER Arthritis of the hip  
 R K GHORMLEY and DR LOW Poliomyelitis  
 WILLIAM ROGERS End result studies  
 Fracture service—2 Demonstration of cases  
 DRS ALFORD and A V BOCK—2 Dry clinic The spleen  
 E P RICHARDSON— Hernia through the diaphragm  
 LINCOLN DAVIS— Cancer of the caecum duodenum and gall bladder  
 DR HANFORD (Presbyterian Hospital New York) and RICHARD MILLER—2 Clinic on surgical tuberculosis  
 DR DALAND— Clinic on plastic surgery  
 DR SHEDDEN—2 Surgical clinic

## Friday

- Staff—9 Surgical operations  
 C A LFLAND—1 Fascia repair of the hernia  
 DRS C A PORTER BREWSTER JONES DAVIS RICHARDSON and WILLIAMS—11 Surgical clinic  
 I B GREENOUGH and associates—2 Tumor clinic  
 DR MCIVER—2 Caecum intestinal surgery  
 DR WILLIAMS—2 Gall bladder surgery  
 DR ALB— Clinic on occupational diseases calcium metabolism in bone  
 A V BOCK— Surgical clinic  
 DR HARMER— Surgical clinic

## PETER BENT BRICHAM HOSPITAL

## Monday

- HARVEY CUSHING—30 X-ray urological clinic  
 FRANCIS NEWTON—30 Dermatology  
 CHANNING FROTHINGHAM—4 Tissue of the chronic appendix  
 F S FULERY JR—430 Study of the results of medical and surgical treatment of peptic ulcer

## Tuesday

- Staff—330 Surgical operations  
 H A CHITTENDEN—30 Medical diagnosis and therapeutic clinic  
 GILBERT HOBBS—330 Cordotomy for the relief of pain  
 J P O'HARE—4 Hypertension and nephritis in relation to surgery  
 DAVID CHEEVER—430 Surgical diagnostic clinic

## Wednesday

- Staff—930 Surgical operation  
 M P SOMMER—30 X-ray study of massive atelectasis of the lung  
 G P GRABFIELD—3 Effect of drugs on the nitrogen metabolism  
 JOHN HOMANS—330 Treatment of varicose ulcer  
 S A LEVINE—4 Heart disease in surgery  
 S B WOLBACH—430 Demonstration in surgical pathology

## Thursday

- Staff—930 Surgical operation  
 W C QUINBY—230 Surgical clinic  
 R H FITZ—3 Insulin in surgical conditions  
 WILLIAM MURPHY and JOHN POWERS—330 Treatment of secondary anemia by liver diet  
 HARVEY CUSHING and TRACY PUTNAM—4 Pituitary gland and its influence on growth

## CAMBRIDGE HOSPITAL

## Tuesday

- Staff—9 General surgical clinics operations and demonstration of cases

## Wednesday

- J W SEVER and F A FRYDAY—9 Orthopedic clinic operations and demonstration of cases

## Friday

- Staff—9 General surgical clinics operation and demonstration of cases

## HARVARD MEDICAL SCHOOL

M d y

DRS GAY LEA d KEEVE — A d b fact n pyl  
nd du d l b t t n chldDRS WOL ACI d BLACK AN — Hem t l l stud  
t p al f t pl ct my i hild nBRONS C OTH S — Stud of inj t th sp l  
c d n i f ntW L MOSS d D FL — Stud n n n l l d  
v i u fu onLLOY D FELTO — P um t b dy l t  
m thol dW LLOYD W COCK a d E H LU HE — I f ntl  
pa l y s m d f p d f l tum p r m t m m t y d p d m lo y  
f th dM J ROS at d H P A R R — F l t l l  
v i u p m nt o pl t h p ndW B CA — C m l t d t f h t  
f t f t tal m t h t mALIA F BR d H VE D — D m t  
f t l t l t l m th d f lf t f t  
Th w l t t p h l t t w l b p f  
l t t y w h t t d t i p l f

th y t m

T d

DR ( M E I K F E — A d b f t  
p l l d d n l t t h l lD W LBACH d BLA K — Hem t l l t l  
th p l f n t pl t m h l lBR C HER — St d f j t th p l  
d f tW I M d D L E — St l b l l  
t fu nI W SMITH — P th l y f t l d g l l  
C l Co — Th b h f t t m ff l w l t p l t d t l t d t  
t t p p at p f m l tH I L ERT — Th b h f l d f t  
th l g th p l h f th p l m eal

h l d h

SHI H S WARRLE — Tl p to f p r t l h  
l y m t f l d p m t l d l lM J SC L I G R — Th f t f h e m t p r p h y  
n m lD s Wo h d H w — Th p th l y f t l  
d h y d w th p al f t b t

h t d tam A d h v ( p h t h m )

H d d y

L OVD D F r v — I m c t b dy l t  
m th d dW I O P A d E H L IER I f t l p l  
mode f p d the f l c t me p m t m m u t y d e p d m l y f th  
dJ W SCHERES HEWSA — Ca c th f h g h  
f q y u tM J RO NAU and H B ANDE NT Filt r bl ru s  
e p r m t s p h l t h r p d ru sW B C A N O V — Compl t d n r n of th b t  
eff t f total y m p th t m yA X F O E S and H L O W E L L D A V S D m t t n  
l b t r y l t l m th d f t y m th

fu ct n of r t t

PHILIP DRINK R — New m th d f a t f i c l r p t  
CECIL K D I N A R a d STEPHEN W R — N w coll dl t l r t n u i n j on as s b t t u t e for  
s m pl l t o l u oLOUIS A SHAW — E p m t s o th vchan f g s  
th gh o m a l t suSTANLEY COBB — Micro op e d m t r t n of ap l a y  
j c t on of the b nH S FORBES — D m t r t on of th cer b a l c i u  
l t n i l t s

Tl day

L W SMITH — P thol y of the thyro d gla d  
C L C R — Th beha r o f e t a n t m s f f owlwh t p l t d t b n t d o t u n t  
r n t p e p r a t n p r f o m u l t s fj t o d f d v p m t  
H R Y P W A K E O N — Th beh f o l s d f t s n  
th l u th path l o g y f th plen m g a l s n

h l d h d

S I L D W R R E Y — P to of p r t o l a d h e o s  
b m n o t f l d v p m n t a l l l c l u l tM J S H E S T C R — Th f t f h e m a t o p h y  
o n m lD s W B A C H d H O W E — Th p th l y f t h  
d h y d w th p l f t b t sh t n d t m A d f i y ( p h t h m )  
F O S T J C O — Tl t t b t w n p t i n dl t l y t o th m p l p b l m r n e d  
th th at of th m t l a h e r f t e m

p m a n e m i

S r e y C O B B — M r p e d m o n t t o n of p l  
l y m i c t o f t h b mH S F — D m a t t f th b r a l u l a  
to l c t

F d y

Conf g l g y th p e d c s g to  
y g y g y n l y d b t t c f r o m g t

## TH ENDINE MEMORIAL — OSTON CITY HOSPITAL

T d y d Tl d y o

G S E R M T t m t f p s u n e m i a  
D M I N O R W E R V d th E p l p y p l l y cc l t n h l l g a t x m i d d o d f t h e  
b l d d l d i m t b o l i m b c t e

r l o y

R P S V G D m s t t i o f e r t a n t u m r f p r a t i c  
mG C S I T R U C L e t u c o t p l d i a s o f g l  
t tS R G C A L L A B O R — M A S S C U E T T S G E N E A L  
H O S L

T d d Tl d

M A M I E E x p m t a l p b l m n t o n  
th t t l o b t r u tJ C W H S b j t b d  
R H S M I C K C l a t y d d f t h e t m

t M A S S C E R A L H O S L

H d d y o

A V B O C K S t d th p h y l g y f m u l w l  
n h l t h d dJ C A U I t r a t s i l m m t a b l m b m  
b o g w t h d pW O T H A P S S t d th y r d d d  
d o g n p h t h m g t th y r u n m y o e d m aC M J N E A c d l b t o b y the s t m a h  
e l f p n f m t h g a t t u n l t r a t

## WARREN MUSEUM

Open daily from 10 to 4 p.m.

Demonstrations by DR. M. CANNAN, Curator

Dwight collection of pines illustrating deformities and anomalies of the eye

Bone tumors with X-ray histories and microscopic slides and microscopes available for examination. Some of these specimens were used in the illustration in the monograph on Bone Sarcoma issued by the American College of Surgeons.

Models showing various types of club foot and effect of operation.

The pictures in Dr. Nichol's collection illustrating pathological conditions of bone.

Fractures and dislocations of bones as they exist before industrial plants provided a means of guard.

Tuberculosis of bones and joints.

Syphilis of bones.

Dislocation of ends of bone.

Collection of old surgical instruments, obstetrical forceps, turn key for extracting teeth, urological tool, cupping, and electric instrument.

## CANNAN HOSPITAL

Monday

A. R. MACAUSLAND—2 Dry clinic. Traumatic injury of the hip joint illustrating.

H. G. LEE—Dry clinic. Fractures of the femoral shaft and of the table of tibia with joint arthroplasty.

D. F. MAHONEY—Dry clinic. Radical operation for carcinoma of the breast and perforating duodenal ulcer with presentation of cases.

Tuesday

F. B. LUND, A. MCK. FRASER and associates—9 Surgical operations.

F. W. JOHNSON, L. E. PHANEUF and associates—9 Gynecological and obstetrical operation.

A. L. BRETT—Dry clinic. Ununited fracture of neck of femur bone cures in fractures fusion of joint.

F. B. LUND, E. J. DRYNUNG and W. F. BROWN—Dry clinic. Chronic duodenal ulcer.

F. W. JOHNSON—Dry clinic. End colostomy for interposition operation for uterine prolapse (lantern slides).

Wednesday

D. F. MAHONEY, W. E. BROWN and associates—9 General surgical operations.

F. W. JOHNSON, L. W. PHANEUF and associates—9 Gynecological and obstetrical operations.

P. V. JEPSON—2 Dry clinic. Relative value of various types of operative bone plating including the massive bone graft treatment of chronic arthritis of the knee operative and nonoperative incidence recognition and treatment of spondylolisthesis over correction of deformities in fractures.

A. MCK. FRASER—2 Dry clinic. Caecostomy in acute appendicitis with peritonitis presentation of cases.

L. E. PHANEUF—2 Dry clinic. The low or cervical caecal section (lantern slides).

Thursday

F. B. LUND, A. MCK. FRASER and associates—9 General surgical operations.

F. W. JOHNSON, L. E. PHANEUF and associates—9 Gynecological and obstetrical operations.

W. R. MACAUSLAND—2 Dry clinic. Mobilization of the knee and elbow.

M. H. BLOMBERG—2 Dry clinic. Scoliosis and club foot.  
E. J. DRYNUNG—2 Dry clinic. Postoperative medical problem pre-operative treatment in cardiac cases.  
L. F. PHANEUF—Dry clinic. Uterine bleeding (lantern slides).

Friday

D. F. MAHONEY, W. F. BROWN and associates—9 General surgical operations.

F. W. JOHNSON, L. L. PHANEUF and associates—9 Gynecological and obstetrical operations.

A. SARCENT and B. A. GODWIN—Orthopedic clinic.

E. J. DRYNUNG—Dry clinic. Intestinal parasites in immigrants.

W. E. BROWN—Dry clinic. Fractures and injuries of the hand and forearm with presentation of special plasters.

I. C. PHANEUF—Dry clinic. Appendicitis and pregnancy.

## LONG ISLAND HOSPITAL

Monday

J. H. CUNNINGHAM and C. S. SWAN—Genito-urinary clinic operation and demonstration of cases.

I. LAWRENCE W. SMITH—Pathological demonstration.

HENRY VIETS—Neurological case.

A. B. MACMILLAN—X-ray demonstration.

Wednesday

P. BERT SOUTTER—Orthopedic clinic operations and demonstration of cases traction in the treatment of fracture treatment of congenital hip.

LAWRENCE SMITH—2 Pathological demonstration.

HENRY VIETS—2 Neurological cases.

A. B. MACMILLAN—X-ray demonstration.

CHARLES LUND—2 Injection treatment of varicose veins operations and demonstration of cases.

Friday

J. H. CUNNINGHAM and C. S. SWAN—Genito-urinary operation.

I. BERT SOUTTER—2 Orthopedic operations.

CHARLES LUND—General surgical operation.

LAWRENCE SMITH—Pathological demonstration.

HENRY VIETS—Neurological cases.

A. B. MACMILLAN—2 X-ray demonstration.

## CLINICS ON INDUSTRIAL SURGERY

At these clinics to be held in the office of the Medical Director of the American Mutual Liability Insurance Company cases will be shown to illustrate diagnosis treatment and end result.

Tuesday

ERNEST A. CODMAN—2 Shoulder injuries.

EDWARD L. YOUNG—4 Inguinal pain without hernia.

Wednesday

P. D. WILSON—2 Fractures of the os calcis injuries to the knee.

RUDOLPH JACOBI—4 Industrial dermatology.

Thursday

FRED J. COTTON—2 Reconstruction surgery in industry.

JOHN D. ADAM—4 Injuries to the back.

Friday

JOHN D. HODGSON—2 Fractures of the skull.

HARRY C. SOLOMON—3 Industrial neurology.

HENRY C. MARBLE—4 Hernia.



## HUNTINGTON MEMORIAL HOSPITAL

Wednesday—Day clinics

E. M. DALAND and G. W. TAYLOR. Carcinoma of the liver  
C. C. SIMMONS and C. C. LUND. Cancer of the tongue  
and buccal mucosa

G. A. LELAND and J. V. MEIG. Carcinoma of the cervix  
R. B. GREENOUGH and C. C. SIMMONS. Varying degrees of  
malignancy in cancer

WILLIAM M. SHELDON and F. P. HAYDEN. Cancer of the  
rectum.

E. M. HERMAN and H. A. KAZANJIAN. Cancer of the  
antrum and accessory sinus

Thursday—Day clinics

WILLIAM DELANE and J. C. HUDSON. The moderm Neph-  
plant

E. M. DALAND and WILLIAM M. SHELDON. Cancer of the  
lip

G. G. SMITH. Carcinoma of the genitourinary tract  
R. B. GREENOUGH and C. C. SIMMONS. Carcinoma of the  
breast

C. C. SIMMONS. Malignant bone tumors  
E. M. DALAND and C. C. LUND. Histopathological treatment  
of malignant disease

## CHILDREN'S HOSPITAL

Monday

A. H. FREISBERG and H. J. FITZGERALD. Tetanoid  
convulsions followed by operation

F. DICKINSON and R. SCOTTEP. Cerebral dissection  
of hypophyseal conference followed by reduced tension and  
help operation

Tuesday

Staff—General surgical operation followed by  
clinic

WILLIAM LADD. Hare lip and left palate

C. G. MINTER. Contracture of scapula and

H. W. HUDSON. Anomalous

G. D. CUTLER and KENNETH BLACKFAN. Empyema and  
lung abscess medical aspect

Staff—Orthopedic clinic infantile paralysis

WILLIAM L. AYCOCK and I. H. LUTHER. Epidemic  
occurrence of scurvy treatment

S. M. FITCHET. Demonstration of apparatus for prevention  
of deformity in early case

MR. MERRILL. Muscle traction

DR. STENDER and FRANK OBER. Tendon transplantation

DR. RYERSON HOKE and A. T. LEGG. Stabilization of  
tibia

A. T. LEGG and FRANK OBER. Operation

Wednesday

W. E. LADD, R. B. OSGOOD and associates—Clinic by  
combined surgical and orthopedic services. Present  
policy in the treatment of glandular intra-abdominal  
bowel and joint tube ulcers

R. B. OSGOOD, W. E. LADD and associates—Combined  
clinic of surgical and orthopedic services. Osteomyelitis—  
acute chronic circumscribed Brodie abscess—  
septic joints type of infection and treatment

Thursday

Staff—Orthopedic clinic

A. TAYLOR and J. W. SEVER. Obstetrical paralysis demon-  
stration of cases (last in list and major part)

DR. VON LACUMY, CANNON, M. A. FELTON and G. W. W.  
BREWSTER. Spinal

BRONSON CROTHERS and Mr. TRAINOR. Muscle training  
G. W. W. BREWSTER. Operation (Stoessel)

Staff—General surgical clinic operation and day clinic

C. G. MINTER. Urinary obstruction and infection

WILLIAM LADD. Kidney stone

THOMAS LAYMAN. Hernia and undescended testicle

C. G. MINTER and S. B. WOLBACH. Kidney tumors—  
pathological aspect

Friday

Staff—General surgical clinic operation and day  
clinic

WILLIAM LADD. Peritonitis

G. D. CUTLER. Idiopathic peritonitis

ALGER THORNDIKE. Appendicitis

C. G. MINTER. Intussusception

WILLIAM LADD. Obliteration of bile duct

Staff—Orthopedic clinic

F. A. PEMBERTON and K. B. OSGOOD. Chronic arthritis  
demonstration of cases

DR. KLEINBERG and G. W. W. BREWSTER. Scoliosis  
demonstration of apparatus and treatment

## BOSTON DISPENSARY

Tuesday

J. H. D. ADAM—Orthopedic operation

H. J. INGLIS—Lipod liposuction

MAYNARD LADD—Post-operative findings in pyloric  
stenosis

Thursday

H. F. DAW—Injection treatment of varicose veins with  
demonstration of technique of case and pathological  
specimen

DAVID DAVIS and H. F. DAW—Gastroenteric disease  
demonstration of cases and method

J. EPHRAÏM—Importance of the physician to the  
urine

NEW ENGLAND HOSPITAL FOR WOMEN  
AND CHILDREN

Tuesday

Staff—General surgical operation

Staff—Obstetrical clinic caesarean section and operative  
diseases prenatal clinic

Wednesday

Staff—General surgical operation nursery and ward  
walk with demonstration of unusual cases prenatal  
clinic

Thursday

Staff—Demonstration of postoperative cases with  
pathological specimens and roentgenogram border  
line cases prenatal clinic

## BETH ISRAEL HOSPITAL

WYMAN WHITEHORE and associates—General  
surgical clinic

E. G. CRABTREE—General Urological clinic

MARK ROGER—General Orthopedic clinic

HERMAN BLUMGARD. Demonstration in medical research  
department

## TUFTS COLLEGE MEDICAL SCHOOL

TIMOTHY LEARY—General Demonstration of specimens  
illustrating results of traumatic especially cranial  
and cerebral



## SURGERY OF THE EYE EAR NOSE AND THROAT

## MASSACHUSETTS EYE AND EAR INFIRMARY

## Tuesday

## Otolaryngology

- PHILIP HAMMOND—9 Simple and radical mastoid operation  
 H A BARNES—9 Malignant diseases of the accessory sinuses  
 H P CARILL—10 Dry clinic Wire gauze brain drain paraffin basket for skin graft of radical mastoid cavity lantern slides of brain cases  
 G H TOBEY—11 Dry clinic Lateral sinus thrombosis the manometer test  
 C B FAUCETT— Lipiodol injections in brain abscess  
 D C SMYTH—3 Lipiodol injections in lung abscess

## Ophthalmology

- G S DERBY—9 Surgery of the eye  
 F H VERHOEFF Pathology of the eye  
 W B LANCASTER Muscles  
 J H WAITT Slit lamp demonstration  
 H B C RIEGER Tear sac operation  
 E B DUNPHY Pinnery  
 T L TERRY Pathology of the eye  
 W H LOWELL Muscles  
 H B CHANDLER Tear sac operation  
 Staff—2 Dry clinic war rounds demonstration of cases

## Wednesday

## Ophthalmology

- DR WHELEDER—9 Surgery of the eye  
 DR HOLLOWAY Thyroid cases  
 G S DERBY Postoperative complications  
 F H VERHOEFF Interpretation of fundi  
 A F McMILLAN Foreign body plus X-ray  
 R C CHENEY Pinnery  
 Symposium—2 Failure in ophthalmology

## Otolaryngology

- G H POIRIER—9 Moshé Total lachrymal sac operation  
 F A SIMMONS—10 Tonsillectomy cases dissection and snare  
 G H POIRIER Sludger technique  
 H P CARILL LaForce technique  
 P E MELTZER Removal with cautery snare  
 A S MACMILLAN—11 Dry clinic Demonstration of accessory sinus and mastoid X-rays  
 D H WALKER—2 Dry clinic Liprading and the deaf child  
 L A SCHALL—3 Dry clinic Pathology of chronic maxillary sinusitis projection of microscopical slides

## Thursday

## Otolaryngology

- V H KAZANJIAN—9 Plastic operations  
 D C SMYTH—9 Dry clinic Fluoroscope and removal of metallic foreign bodies  
 H P MOHER—10 Exhibition of fluoroscopic examination of the esophagus  
 A S MACMILLAN—11 Lantern slide demonstration of esophageal cases  
 DR KIRBY—2 Demonstration of Baranovsky tests  
 F E CARLAND—3 Infection of the submaxillary gland

## Ophthalmology

- AILEEN GREENWOOD—9 Surgery of the eye  
 C S DERBY Eye plus internist  
 F H VERHOEFF External diseases  
 I M CARVILL Tuberculosis of the eye  
 J H WAITT Demonstration of Gullstrand lamp  
 H B CHANDLER Perimetry  
 C S DERBY and CHENEY—10 Eye plus internist  
 C S DERBY—11 Light senescence  
 H B C RIEGER External diseases  
 F H VERHOEFF Pathological demonstration (lantern slides)  
 DR HOLLOWAY Eye and intracranial conditions

## Friday

## Otolaryngology

- V H KAZANJIAN—9 Correction of deformities of the face and nose lantern slide demonstration  
 H P MOSHER—10 Punch tractotomy  
 A S MACMILLAN X-ray of thymus (lantern slides)  
 F I GARLAND—11 Historical exhibit of laryngeal instruments  
 H P CARILL—2 Lantern slide demonstration of serial sections of the ear  
 D H WALKER—3 Liprading and the deaf child

## Ophthalmology

- F H VERHOEFF—9 Surgery of the eye  
 C S DERBY and AYER Nerves of the eye  
 DR SMITH Social work  
 J H WAITT Uveitis  
 H B C RIEGER Trachoma  
 B SACHS Perimetry  
 C S DERBY—10 Preventive ophthalmology  
 Staff—2 Dry clinic Chronic simple glaucoma and secondary glaucoma diagnosis significance and importance of various signs significance of glaucoma as a cause of loss of vision and the remedy choice of operation treatment of secondary glaucoma

## CARNEY HOSPITAL

## Tuesday

- W S LIEBMAN—9 Eye operations and demonstration of cases X-ray localization and magnet extraction of foreign bodies

## Wednesday

- E D HURLEY and W S LIEBMAN—9 Eye operations and demonstration of cases

## Thursday

- W S LIEBMAN and H BORNHOFF—9 Eye operations and demonstration of cases

## Friday

- W J SHEPHERD and F G MINSTER—2 Otolaryngological clinic

## BETH ISRAEL HOSPITAL

- L V FRIEDMAN and L ARAN—9 daily Nose and throat clinic

## CAMBRIDGE HOSPITAL

- N S BACON and E J BUTLER—9 Thursday Nose and throat clinic



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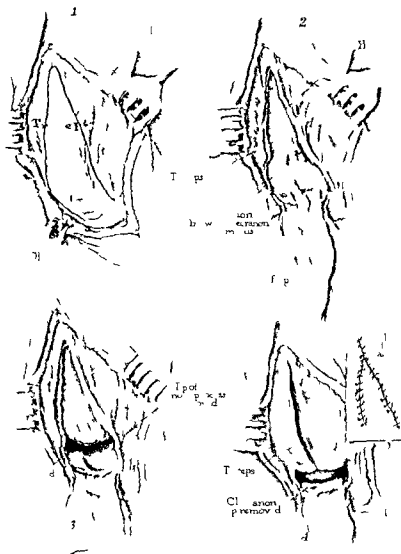
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LUKENS PICTORIAL TECHNIQUE  
BONE AND JOINT SERIES  
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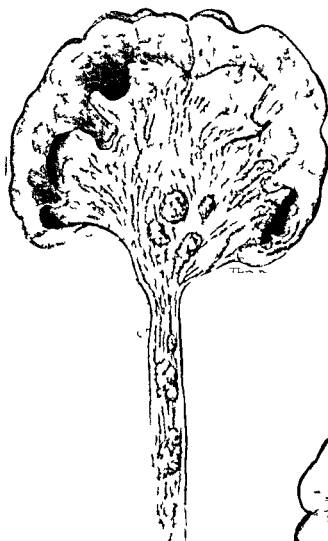


Fig. 3



Fig. 4

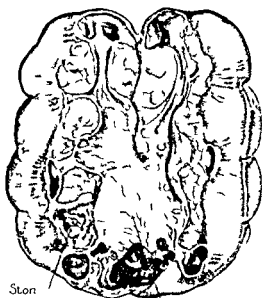


Fig. 5

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m d th gh th d p  
Fg H S C N t th l g  
pl q f l c pl k T m ll st  
bl  
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l pl k f m t n n l th t  
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# SURGERY, GYNECOLOGY AND OBSTETRICS

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## LEUCOPLAKIA OF THE URINARY ORGANS<sup>1</sup>

A REPORT OF THIRTEEN NEW CASES

By HERMAN I. KRITSCHWIR, M.D., I.A.C.S., CHICAGO  
F. M. P. 1y H. I. I. R. H. M. I. C. H. g

**L**EUCOPLAKIA of the urinary organs has until quite recently received but scant attention in American literature. A number of very interesting cases have been reported within the past few years by authors who have very carefully brought the literature up to date. I refer especially to the recent publications by Briggs and Maxwell, Cumming, Hennessey, Hinman, Kutzman and Gibson, Valentine, Wilhelm and Young.

Most of these articles deal with the cases in which the condition affected the urinary bladder, the ureter or the kidney pelvis. Leucoplakia of the urethra is not so common; at least this is the impression which has been gathered from a more or less casual perusal of the literature.

In two previous publications I reported three cases. In two cases the kidney pelvis was the seat of the disease and in one the urinary bladder and the ureter were involved. Since the publication of these papers, articles have appeared in the European literature by Allemann, Broglio, Cirillo, Corsdres, Jura, Lavirghi, Pedroso and von Borzi.

In this paper no attempt will be made to review the literature, because this was done in one of my earlier papers as well as in some of the papers mentioned. Hennessey's paper, published in January 1927, shows a total of 79 cases reported in the literature. This with the 13 cases which I shall describe makes a

total number of 92 cases which have been reported to date.

In 7 cases the bladder was affected, in 3 the urethra, in 2 the kidney pelvis and in 1 the kidney pelvis and ureter were affected.

The various theories regarding the pathogenesis have been reviewed so many times in recent publications that they will not be considered in this paper. Those who are interested in the theories, as well as in the role played by the presence of tuberculosis, chronic infection and stone, may refer to these articles.

SEX

In a previous study of the subject of leucoplakia in which an extensive review of the literature was made, we found 34 cases in males, 8 cases in females and 1 case in which the sex was not stated. In the present series there are 9 males and 4 females.

In a recent review of 75 cases, Hennessey found that this lesion occurred in the male 56 times and in the female 19 times, a ratio of practically 3 to 1. Hinman, Kutzman and Gibson in their paper, stated that at least in the kidney pelvis the incidence was equal in the two sexes.

AGE

Age probably has no etiologic significance. Table I shows the distribution in our series.

R d t t h u l m t g f t h m A o c t C U l g y S g n s W h g t A p l 3 M y d 9 S U l g l f d



TABLE I—INCIDENCE

A	Ag
y	C
3	47
33	48
34	55
4	6
44	6

Total 3

## SYMPTOMS

The symptoms of this condition are not typical. In many instances a coexisting pathological condition presents symptoms and signs which predominate the clinical picture, the leucoplakia being found at the time of cystoscopic examinations in patient in whom the condition is limited to the bladder or the condition is observed when the kidney having been removed is opened for study. Nevertheless many authors mention the passage of large flakes of epithelium as pathognomonic of the presence of leucoplakia. Perhaps it might not be amiss to present the most frequently found symptoms in this series of cases in the form of a table (Table II).

TABLE II—SYMPTOMS

F	q	n	y	f	t	n	C	B	k	h
N	t						7	R	t	t
B	g						7	C	l	d
H	u	m	a	t	a		5	U	g	
P	i						5	N		
P	i				t		4	N	m	u
P	y						4	W	k	n
T	b	d			e			T	l	g
D	f	f			l	y		T	l	g
I	t				e			f	j	
L	o				f	w				

## BACTERIOLOGY

Whether or not infection plays a role in the production of leucoplakia is open to question. Here as in the role played by symptoms, the question of infection is often secondary, or subservient to the underlying primary condition. In our series the histories show that in 2 cases the urine was sterile and free of infection, whereas in 8 cases infection of one sort or another was present. In 3 cases the cultures were not stated. In the patients with tuberculosis of the kidney and bladder both showed the presence of tubercle bacilli on smear and guinea pig inoculation.

One of the interesting phases of the subject is the fact that the bacteriological studies of the urine failed to show the presence of any one organism in all of the cases, although bacillus coli either alone or in combination was the most frequent invader. This lack of constancy is also evident in the literature. Furthermore in some cases the urines were sterile, notably in the cases of Cumming and Corsdres, Hinman, Kutzman and Gibson. Wilhelm found the bacillus proteus, Wilhelm found staphylococci, Hennessey bacillus coli and staphylococci, and Valentine streptococci and gram negative bacilli. Tables III and IV show the bacteriological results in our series.

TABLE III—BACTERIOLOGY

B	O	m	C
B	ll		4
B	ll	l a d l a m b t t j t c	
B	ll	l d t phyl c	
B	ll	l d t j t	
St	ad		
N	t	tat l	3

Total 3

TABLE IV—URINALYSIS

All	m	C
Pu		11
B	t	7
Blood		7
Ej	th l l ll	5

## PREVIOUS VENEREAL HISTORY

For a time it was suggested that perhaps syphilis was a factor in the production of leucoplakia. Among the champions of this viewpoint may be mentioned Podas who believed that leucoplakia in most instances offered a pathology the origin of which could be traced back to syphilis, because specific treatment had proved effective. In our present series a Wassermann test was made in 9 cases and was positive in 1 case. Nevertheless the present opinion I believe is rather against the possibility of syphilis as an etiological factor. Gonorrhea too has been held responsible but in my opinion it can be excluded. The majority of patients in this series denied ever having had gonorrhea, and on examination no evidence of that disease was found.

## ASSOCIATED LESIONS

Various authors have from time to time included in their reports the detailed study of

coexisting lesions. There was a time when it was believed by some that leucoplakia occurred only when associated with stone and hence was due to the presence of stone either directly or indirectly. This viewpoint we now know to be erroneous because leucoplakia may occur in many instances as an independent disease. A review of this series of cases give the results shown in Table V.

TABLE V — ASSOCIATED PATHOLOGY

Urethra	
1	Traumatic stricture
2	Urethral calculi with rupture of the urethra
3	No associated pathology
Bladder	
1	Stone with chronic cystitis
2	Carcinoma with chronic cystitis
3	Ulcerative cystitis with pyelonephritis
4	Tuberculo- of the bladder secondary to renal tuberculosis
5	Chronic cystitis with median bar of traction (fluid kidney pelvis left)
6	No associated pathology (double kidney and 1 ureter)
7	No associated pathology
Kidney	
1	Renal calculi
2	Renal tuberculous
3	Hydronephrosis (infected)

CASE 1. D. G. male aged 44 years. The patient's previous history was negative. He had had the usual diseases of childhood and denied venereal disease. The family history was negative. On April 21, 1921, while at work on a crane at a cinder pit, the patient fell on a steel rail in the pit striking upon the perineum. There was bleeding from the external urethral orifice and in less than 12 hours complete retention of urine. The next morning he was taken to a hospital and the bladder was drained per catheter for 2 days. A few days later an abscess formed in the scrotum and was opened and drained. A second abscess which opened spontaneously developed in the scrotum after the first one healed. Until the abscesses were healed the urine was passed through the incision. The patient remained in the hospital 5 weeks.

After the patient left the hospital he noticed that he did not empty the bladder and was obliged to exert pressure on the perineum with his hands after the act of urination was apparently completed. The same was true of ejaculation; the semen was not ejected at the time of ejaculation but had to be forced out by pressure on the perineum. The sexual act was otherwise normal. Since the accident he had had some tingling in the perineum which was present only during urination. Urgency was also present occasionally. There were no other urinary symptoms present.

General physical examination was negative. There was a small scar at the penoscrotal junction the

site of the incision for draining the abscess. Some thickness and hardness at the penoscrotal junction was felt. A varicocele was present on the right side. Rectal examination was negative. Blood pressure was 122-80. Roentgen ray examination showed a healed fracture of the pelvis. Urinalysis gave the following results: color clear, reaction acid, albumin none, no blood, sugar, casts or red blood cells, pus cell rare. Cystoscopic examination was negative. Urethroscopic examination (Fig. 1 from tipicce) showed in the bulbous urethra a white, dry, lusterless area about the size of a bean. The surface was wrinkled almost scaly. The edges were sharply defined and stood out in marked contrast to the normal mucosa. The posterior urethra was negative. Exploration of the urethra with a No. 27 diagnostic sound showed a very firm band at the penoscrotal juncture.

Diagnosis: traumatic stricture of the urethra, leucoplakia of the urethra.

CASE 2. J. W. K. male aged 55 years had had mumps and scarlet fever in childhood, rheumatism at 43, influenza at 50, urethritis complicated with bilateral epididymitis many years ago. The family history was negative. The patient stated that for the past 2 years he had noticed a lump under the urethra which had been gradually growing larger and had always been hard and firm. Four days before coming under observation the swelling evidently ruptured into the urethra as blood was passed. Nevertheless the size of the swelling had remained about the same.

During the past year there had been a good deal of difficulty in urination which had become more noticeable with the increase in the size of the lump but there had never been complete retention. No catheter had ever been used. The patient urinated every 2 or 3 hours during the day and 3 or 4 times at night. A week prior to admission to the hospital the patient developed chills and fever which had been present daily since then. He was obliged because of apparent obstruction of urine to strain a good deal, the force of the stream being practically nil and the urine merely dribbling away. Sexual symptoms were absent.

The patient had had a cataract of the left eye. The teeth were in poor condition and the pharynx was injected. Several glands of the neck were enlarged. The lungs were negative. The heart showed a mitral murmur transmitted in the axilla. Examination of the abdomen was negative. Small inguinal glands were present on the left side. On the right side was a scar, the result of an operation for hernia. The external urethral orifice was negative. A hard mass was felt at the root of the penis and extended back along the urethra almost to the front of the rectum. The perineum was swollen and sensitive and had the appearance of being edematous. An attempt was made to pass a urethral sound but an obstruction was met and had a gritty feeling as though the tumor mass were due to stone. Rectal examination was negative. Roentgen ray examina-

tion showed stones in the urethra. Examination of the blood showed red blood cells 4,736,000 leucocytes 18,000 hemoglobin 95 per cent. Wasermann test as negative. Gonococcus fixation test as positive (4+). Urinalysis showed color turbid odor foul albumin 3+ sugar none sediment pus and red blood cell.

Diagnosis: multiple urethral calculi with urinary stricture.

Operation was performed under gas anesthesia on April 15, 1922. An incision was made in the median line over the tumor and carried back on the perineum. A large amount of pus and urine escaped. The bulbous urethra was opened for inches and a large stone and several small rounded stones were removed. When the urethra was opened several cases were seen that were in direct contact with the stones and were white and dried and had the typical appearance of leucoplakia. These patches were excised for histological study and the diagnosis of leucoplakia was verified. The wound was closed in the usual manner and drains were inserted. The immediate postoperative convalescence was rather trying due to infection following the urinary extravasation. The wound was irrigated daily. Culture of pus from the wound showed colon bacilli and diphtheria.

On June 18 the wound was closed and the patient was given permission to leave the hospital. During the night he suddenly developed dyspnea, profuse perspiration, bloody sputum, a sense of weight over the sternum and a very productive cough. The patient died on June 19 of pulmonary embolism. Permission for an autopsy could not be obtained.

Diagnosis: urethral calculi, rupture of the urethra, leucoplakia of the urethra, pulmonary embolism.

CASE 3. Miss B. M., 8 years of age, referred by Dr. W. E. Post was admitted to the Resbyteria Hospital on May 1923. She had had the usual diseases of childhood. Her appendix had been removed 9 years prior to admission to the hospital. The patient complained of pain in the lower quadrant of the abdomen which had been present for 9 years. Pain in the bladder region for 2 months had been severe, sharp and marked at urination.

The patient was a slow undernourished woman of a erythematous type. Her pupils reacted to light and accommodation. The sclerae were pale. Examination of the ears, nose, throat, heart and lungs was negative. The abdomen showed some tenderness in the right lower quadrant over the colon. Kneelocks were extremely brisk. Pelvic examination showed the uterus in *secundo* degree retroversion and not easily lifted. When the lips of the urethra were everted two white, dry, dull patches of leucoplakia could be seen. One of these patches was located on the floor of the urethra and on the lateral wall. Cystoscopic examination on May 23 was negative. The ureters were catheterized without difficulty or obstruction. Examination of the urine from the bladder showed bacillus coli that from the kidney, staphylococci. Urine from the left kidney was

sterile. The roentgen ray examination was negative for stone. Pyelograms were negative. Blood examination showed red blood cells 5,100,000 leucocytes 6,000 hemoglobin 66 percent. Blood pressure was 90/50. The Wassermann test was negative. Many specimens of bladder urine were examined and were negative for tubercle bacilli. Examination of catheterized specimens on June 2 showed from the bladder 1 leucocytes per cubic millimeter cultures showed bacillus coli but no tubercle bacilli. Urine from the left kidney showed 1 leucocytes per cubic millimeter cultures were sterile. Tubercle bacilli were found.

Guinea pig tests on May 24, 1923 showed for the bladder specimen a negative result for tubercle bacilli on July 26, 1923 and June 8, 1924. Urine from the bladder and right and left kidney were negative for tubercle bacilli.

Diagnosis: retroversion of the uterus, malnutrition, hydrosalpinx, leucoplakia of the urethra.

CASE 4. J. C. male aged 47 years was seen through the courtesy of Dr. Perry Bromberg of Nashville, Tennessee. The patient was admitted to the St. Thomas Hospital at Nashville on December 10, 1922. The family history was negative. The patient's previous history was negative except for an attack of epididymitis 8 years prior to his admission to the St. Thomas Hospital. For the past 15 years it had been difficult for the patient to urinate. He stated that the straining was very easy to start and at first flowed freely but when the act was about half finished the flow gradually slowed down to a dribble and finally stopped. He was forced to wait a few seconds and then after relaxing as able to finish. Straining seemed to aggravate the condition and at times blood tinged urine was passed. When the straining began to slow down he suffered from a burning pain over the symphysis which radiated toward the rectum. Frequency of urination had been present for many years and at the time the patient presented himself for examination he urinated every hour during the night and 10 to 12 times during the day.

Physical examination disclosed the following: Head and neck were negative except for the very poor condition of the teeth. Heart and lungs were negative. Examination of the abdomen showed some tenderness over the symphysis pubis extending upward about midway to the umbilicus and outward to the outer border of the rectus muscles. The external genital area was negative except for the hypertrophied clitoris. The rest of the normal examination of the urine showed specific gravity 1.06 alkaline reaction a trace of albumin no sugar or cast but an occasional red blood cell. Phenolphthalein test showed a total output of 1 percent for 2 hours. The blood urinalysis showed 13,000 leucocytes. Blood chemistry showed a 30 uric acid nitrogen 18 nonprotein nitrogen 25. X-ray examination showed a very large stone in the bladder.

Operation was performed by H L Kretschmer at the St Thomas Hospital Nashville Tennessee December 12 192 (courtesy of Dr Bromberg) Through a suprapubic cystotomy a very large stone measuring 7.5 by 6 by 4.5 centimeters and weighing 6 ounces was removed At the time the bladder was opened multiple areas of leucoplakia were found These were removed surgically and sections were examined by Dr B I Terry of Nashville who verified the diagnosis of leucoplakia

Diagnosis stone in the bladder leucoplakia of the bladder

CASE 5 R A male aged 62 years referred by Dr R B Ole on was admitted to the Presbyterian Hospital Chicago on March 24 1927 The patient's father died at the age of 72 years of carcinoma of the stomach His mother died at the age of 49 years of carcinoma of the lungs The patient had had gonorrhea at the age of 20 years but this had cleared up without complications Syphilis was denied The patient stated that he had always had more or less bladder trouble He had had frequency of urination with burning and nocturia for 3 years These symptoms had recently become aggravated so that 1½ years before coming under observation he noticed that his urine had become turbid and contained a large amount of sediment He also noticed at that time some discharge at the end of urination Frequency of urination had gradually increased so that he was obliged to urinate about every 40 minutes during the day and about 10 or 15 times during the night Hematuria began about 1½ years before he came under observation It was most marked at the end of urination He had had some deep X ray treatment which he believed increased the pain frequency and hematuria

Physical examination showed head neck heart and lungs negative The liver could be felt 2 fingers breadth under the costal arch The external genitalia were negative Rectal examination showed a normal prostate The base of the bladder felt as though it were greatly thickened Blood chemistry urea 11.3 uric acid .5 creatinin 1.55 Blood Wassermann test gave negative results Urinalysis showed reaction alkaline albumin 4+ no sugar blood + pus 4+ sediment red blood cells and motile bacilli A catheterized specimen of bladder urine showed 240 leucocytes per cubic millimeter cultures staphylococcus albus and bacillus coli Roentgen ray examination was negative for stones in the genito urinary tract Cystoscopic examination under sacral anesthesia March 25 showed a large white necrotic tumor mass about the size of an apple extending around the neck as well as around the base of the bladder A great deal of redness of the vesical mucous membrane and some edema were present A diagnosis of carcinoma of the bladder was made

Operation was advised and on April 1 we did a suprapubic cystotomy and applied surgical diathermy to the tumor mass The bladder was opened and a very large flat necrotic tumor was seen which

extended from the upper part of the bladder down to the urethral orifice to the left side as far over as the base of the bladder A very large area of leucoplakia was seen on the right side of the bladder base and wall A small section of the tumor mass was removed for histological study and the tumor was treated extensively with surgical diathermy A section was removed from the area of leucoplakia for histological study and the area was given a very thorough diathermy treatment Convalescence was uneventful

Diagnosis bladder carcinoma leucoplakia of the bladder

CASE 6 Mrs T McD widow aged 44 years referred by Dr E Spiegelberg was admitted to the Presbyterian Hospital December 23 1925 She had had measles mumps and scarlet fever during childhood One sister died of carcinoma of the uterus at the age of 44 years

About weeks before entering the hospital the patient was suddenly seized with severe pain in the right upper quadrant This was described as sharp in character It remained localized and did not radiate The attack lasted for 8 hours The second attack of pain radiated from under the right costal margin to the back A doctor was called who gave morphine to relieve the pain She had been troubled with nocturia for about 20 years At first the nocturia was infrequent but at the time of admission she was obliged to urinate 3 or 4 times every night Frequency during the day had begun 3 years previously and had gradually increased At the time of examination the patient was obliged to urinate every hours The pain in the bladder was described as an aching pain It had bothered her for many years but was always relieved by urination A certain amount of urgency of urination was associated with this pain

Physical examination showed that the pupils reacted to light and accommodation The teeth had many crowns Examination of the tonsils neck heart and lungs was negative Examination of the abdomen showed some rigidity and a palpable mass in the right upper quadrant which was tender there was some rigidity on the right side posteriorly The reflexes were normal Examination of the blood showed red blood cells 5 420 000 leucocytes 19 300 hemoglobin 90 per cent Blood pressure was 104-62 Roentgen ray examination was negative for stones Cysto copic examination on December 6 (under sacral anesthesia because of extreme irritability of the bladder) revealed flakes of pus adhering to the bladder mucous membrane The ureters were normal Cystoscopic examination (sacral anesthesia January 4 1926) showed considerable redness of the trigone flakes of pus sticking to the trigone the right ureteral orifice gaping the mucous membrane in the region of the left ureter velvety Both ureters were catheterized without difficulty or obstruction The urine from the right side was turbid with large flakes of pus The urine from the left side was slightly turbid with specks Urinalysis (ad

mssion specimen) showed alkaline reaction some albumin no sugar no blood some leucocytes small many epithelial cells a few leucocytes and many crystals

Examination of catheterized specimens for one showed from the bladder 520 leucocytes per cubic millimeter no casts culture showed bacilli coli Urine from the right kidney showed 650 leucocytes per cubic millimeter no casts culture showed bacillus coli Urine from the left kidney showed 540 leucocytes per cubic millimeter no casts culture sterile Repeat examination of the urine were negative for tubercle bacilli Guaiacum negative Tests December 24 1905 from bladder urine and right kidney December 6 1905 from bladder December 31 1905 from bladder and left kidney 1906 from bladder and right kidney all cultures were negative for tubercle bacilli Peligum showed no milkiness

The patient left the hospital on January 6 1906 after a short stay on January 5 She complained at the time of pain in the right side of the back of the lumbar region on urination feeling fullness after eating vomiting jaundice and pain in the hypogastrium These symptoms began shortly after the first hospitalization

Physical examination showed that the patient's skin and the sclerae of the eyes were free from jaundice The mass in the right upper quadrant was much larger and more easily palpable Blood examination on January 5 showed dilated red blood cells 3 500 000 leucocytes 5000 hemoglobin 80 per cent blood Wasserman positive The patient was examined by Dr. Ralph C. Broome and Dr. D. B. H. M. T. T.

Diagnosis Carcinoma of the stomach the metastases in the liver

Exploratory operation was done February 8 by Dr. I. H. M. T. and carcinoma of the stomach with metastases in the liver and obstruction of the bladder was found The patient died on February 7

Aatomical diagnosis is as follows carcinoma of the gall bladder with metastases to the liver and the pancreas distended ureter pyelohidrosis carcinoma of the urinary bladder with bilateral hydronephrosis and hydronephrosis The lining of the urinary bladder was a large granular About the trigone and extending up to the fundus all the lateral folds were flat irregular slightly elevated white plaques of the urinary bladder 3 or 4 millimeter in diameter Several of these small white plaques were removed for histological study

Histological diagnosis is leucoplakia of the urinary bladder adenocarcinoma of the glandular bladder with metastases to the liver

Case 7 T. M. male aged 60 single married by Dr. D. L. as admitted to the hospital on July 10 1906 The patient stated that he had had more or less urinary distress for 3 years consisting of frequency burning and pain on urination also nocturia Frequent smearing marks in the night than in the day It gradually increased until he was obliged to void about every 2

hours during the day and night Hematuria began about 2 years ago and blood had been present in the urine from time to time The patient thought that pus had been present in the urine practically all of the time

The patient was a well developed and well nourished male The examination of the head neck heart lungs abdomen external genitalia and testicles was negative Several examinations of the spinal cord lesions disclosed negative findings Rectal examination showed a small prostate and the margins of the left lobe were hard—questionable for tuberculous Blood examination leucocytes 12 400 hemoglobin 90 per cent Blood chemistry blood sugar 150 urea 65 uric acid 5.6 creatinine 3 non protein nitrogen 60 Uric acids showed a reaction alkaline albumin 4+ some blood in sugar no casts sediment leucocytes epithelial cells phagocytes The essential urine amounts varied from 100 to 360 cubic centimeters

Cultures of the urine July 17 1906 revealed a large amount of leucoplakia around the internal urethral orifice beginning above and extending to the right side about halfway down to the base Examination of a culture of the specimen of urine July 18 showed from the bladder 84 leucocytes per cubic millimeter Cultures were sterile for tubercle bacilli and the urine was negative for tubercle bacilli Repeated examinations of bladder contents were negative for tubercle bacilli Guaiacum negative Tests on July 25 and 27 from the bladder positive for tubercle bacilli Examination of catheterized specimen of urine from the bladder on August 8 positive for tubercle bacilli

Diagnosis leucoplakia of the bladder renal tuberculosis

The patient died on March 24 1906 uremia in the fortuitously an autopsy could not be obtained

Case 8 I. M. B. male aged 34 years was admitted to the Presbyterian Hospital No. 61 on February 2 1907 He was seriously ill the patient had had gonorrhea infection complicated with gonorrhea of the urethra The patient's illness began July 1907 when the patient acquired a gonorrhea infection Several weeks subsequently epididymitis developed at which time he suffered from gonorrhea of the great frequency of urination and nocturia Present in the urine and there was almost constant dribbling The burning was most marked along the urethra The acute symptoms soon subsided and irrigation and massaging of the prostate were instituted In November hematuria developed a large lot of pus passed The urine was cloudy turbid and had a foul odor

Physical examination showed the following negative the tonsils moderately enlarged the lymph glands in the neck palpable the testicles negative the heart and lungs negative Examination of the abdomen was negative The external urethral orifice showed no urethral discharge The vas deferens and spermatic cord were normal The left epididymis The left cord was slightly enlarged

and tender. On rectal examination the margins of the right lobe were easily palpable the margins of the left lobe could not be outlined as they fused with the bony pelvis. The left seminal vesicle was exceedingly hard and broad and seemed to be in one mass with the prostate. The right seminal vesicle was soft. Strippings from the prostate showed a few gonococci.

Treatment consisted of baths, internal medication and sedatives. The condition remained unimproved and on account of his unfavorable state of health the patient was sent to the hospital.

Blood chemistry, December 10, showed urea 10.5, uric acid 4.1, creatinin 1.5, non-protein nitrogen 27.8. Blood examination showed red cells 4,390,000, leucocytes 13,250, hemoglobin 80 per cent. Blood Wassermann was negative. Blood pressure was 138-108. Examination of catheterized bladder urine, December 6, showed 79,000 leucocytes per cubic millimeter, sterile cultures, and no tubercle bacilli. Cystoscopy under deep ethylene anesthesia, December 7, disclosed a severe generalized cystitis, some bleeding from the neck of the bladder, the interurethral ligament markedly hypertrophied and at the base of the bladder multiple areas of ulceration and a large median bar. Both ureters were catheterized without difficulty or obstruction. Examination of catheterized urines showed from bladder 27,200 leucocytes per cubic millimeter from right kidney, 40 leucocytes per cubic millimeter from left kidney, 10 leucocytes per cubic millimeter. Smears showed no organisms, cultures were sterile. Pyelograms showed a bifid pelvis of the left kidney, the lower end of the ureter dilated and the right kidney normal.

After failure to obtain relief through the usual forms of treatment, a suprapubic cystostomy was performed on December 14. The bladder wall was found to be exceedingly thick. The mucous membrane over the trigone was markedly hypertrophied, thick and granular. Around the neck of the bladder was seen an area of ulceration which completely surrounded the internal urethral orifice and bled very easily. The bladder neck was exceedingly tight and a definite median bar was seen. On the posterior wall there was an ulcer about 2 1/2 inches long. On the posterior wall 2 white areas of leucoplakia were found.

Diagnosis: median bar hypertrophy with contraction of the internal urethral orifice, ulcerative cystitis, leucoplakia of the bladder and bifid kidney pelvis (left).

CASE 9. Mrs. R. S. aged 53 years, referred by Dr. D. B. Phenister, was admitted to the Presbyterian Hospital, January 7, 1926. The family history was negative. The patient had been married 9 years and had never been pregnant. Eleven years before admission to the hospital the patient had begun to have frequency of urination associated with marked urgency and some incontinence. The condition remained about the same and several years later she began to notice that some of the urine

appeared cloudy. Passage of urine was accompanied with a burning sensation. For this she had been treated with bladder lavage for 2 or 3 years and the condition had improved somewhat. The pain in the left renal area started in 1923. It radiated along the course of the left ureter, was sharp and cutting and interfered with the patient's sleep. She was obliged to urinate every 10 or 15 minutes during the day and 4 or 5 times at night, sometimes more often than this.

Physical examination of the head, neck, heart, lungs and abdomen was negative. Blood examination showed leucocytes 11,100, hemoglobin 88 per cent. Blood pressure was 104-70. Roentgen ray examination was negative for stones. Urinalysis showed acid reaction, albumin 3+, no sugar, blood 3+, pus 2+, Thalein test showed in output of 55 per cent in 1 1/2 hours. Time of appearance was 5 minutes.

Cystoscopic examination, January 28, 1926, showed a large, dull white wedge shaped area about the size of a silver dollar, extending from in front of the air bubble above to or nearly to the internal urethral orifice below. The margins of the mucous membrane of the bladder were hyperemic. A similar area was seen on the trigone in front of the right ureteral orifice. The ureters were catheterized without difficulty or obstruction. Examination of the catheterized specimens of urine showed from the bladder 1240 leucocytes per cubic millimeter. Cultures showed bacillus coli but no tubercle bacilli were found. Urine from the right kidney showed 5 leucocytes per cubic millimeter. Cultures showed bacillus coli and streptococcus hemolyticus but no tubercle bacilli. Urine from the left kidney showed 5 leucocytes per cubic millimeter. Cultures showed bacillus coli but no tubercle bacilli. Guinea pig inoculations of urine from the bladder and the right and left kidney were negative for tubercle bacilli.

Cystoscopic examination, February 2, verified the findings of the first examination. At this time however two ureteral openings were found on the left side, one of which had been overlooked at the first cystoscopic examination. The two left ureters were catheterized with the following results: from the lower left kidney no leucocytes, sterile cultures, no tubercle bacilli; from the upper left kidney 1 leucocyte per cubic millimeter, sterile culture, no tubercle bacilli. Guinea pig inoculation, February 1, showed that urine from lower left kidney and upper left kidney were negative for tubercle bacilli. A pyelogram showed a double kidney pelvis and double ureters on the left side.

Diagnosis: Leucoplakia of the bladder, double kidney pelvis and double ureters (left).

CASE 10. Mr. C. W. aged 48 years, referred by Dr. W. E. Post, was admitted to the Presbyterian Hospital, November 30, 1923. The previous history was negative except for a gonorrheal infection 20 years prior to examination. One year ago the patient consulted a physician for so called rheumatism.

t m He as told that the rheumatism was due  
 to an infecte d i v r t i c u l u m of the bladder In June  
 19 3 the d i c t i o n a r y as removed and the rheu  
 m t i m i m p r o d After the operation the patient  
 as t o u b l e d with frequency of urination which gave  
 him a good deal of distress At times he as of liged  
 to v o i d e v r y 15 m i n u t e s d u r i n g t h e d a y a n d 3 t i m e s  
 a t n i g h t He also not c d h e m a t u r i a a n d s t a d t  
 h a t b e f o r e t h e o p e r a t i o n h e h a d i n v e r s e n b l o o d  
 i n t h e u r i n B u r n i n g a d s m a r t i n g a t t h e b e g i n n i n g  
 o f e n d o f u r i n a t o n w e r a s s e i t d i t h f r e q u e n c y  
 a n d h e m a t u r i a a n d e x t e n d e d f r o m t h e t p f i t h  
 p u n t o t h a n u s H e h a d b e e n u n a b l e t o w o r k  
 m u h s i n c e t h e o p e r a t i o n o n a c c o u n t o f k n e e s  
 H h a d l s t a b o u t 35 p o u n d s i n e i g h t H a l  
 o m p l e d o f r h e u m a t i s p n s i n t h e h i p k n e e s  
 b a c k a n d h o u d l s

Physical examination of the head and neck was negative. Eyes found in both normal. The heart and lungs were negative. The abdomen showed a carcinoma at the symphysis pubis but was otherwise negative. Examination of the external genitalia was negative. Rectal examination disclosed a very large hard and firm prostatic mass protruded pus and ulcers. It showed streptococci. No residual urine as found. Blood examination showed red cells 5,346,000, leukocytes 6,600. Blood protein as 0.7. The blood was examined test was negative. Roentgen ray examination of the teeth showed apical abscess. The gastrointestinal examination was negative. Urinalysis examination was negative. Urine was turbid. Specific gravity was 1.020. Alkaline phosphatase present some blood but no sugar was present. The sediment of pus and epithelial cells. Cystoscopic examination of

mber 7 sh d two area of leucoplakia on the  
 anter r wall and on the left lateral wall and a  
 merite amount of cystitis Both ur tests re  
 c thetized thout difficulty or obtruction Exam  
 n to of the cathetized specmen of blad  
 ure sho ed bacilli coli Sm a s made from the  
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 r htk in p ania 4 fr mth left ki ey Cultu es  
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 tub rcl bacilli fom the bladder and bth kid eys  
 l lograms sh d norml ki ln ys T o ubse  
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 th m fin l gs sld the first x mation With  
 a sto copic ong u a p e of ti ue as r moved  
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 of leu o l ki

CASE 11 I O B female ag d 34 years married  
was admitted to the Presbyterian Hospital April 14  
1926. She had two children living and well. She  
had had the usual diseases of childhood. Her father  
died of cardio renal disease at the age of 74 years her  
mother died of a paralytic stroke at the age of 53  
years. Other in the family history was negative.  
The present illness began a year ago when the pa-  
tient noticed burning on urination just before the  
act was finished. The burning increased in severity  
so that at the time of examination it was continuous.  
For this she had had some treatment which failed to  
give relief. Frequency of urination began with the  
burning. At times she urinated every 3 minutes  
at easier periods every 2 to 4 hours. She had had to  
urinate at night for the past 2 years the first year  
once or twice during the night the second year 3 or  
4 times a night. Urgency had been present for a  
year and when desire came she had to respond im-  
mediately. About 10 months ago she noticed blood  
at the end of each urination. The urine was dark  
therefore the blood must have been fresh. No such  
manifestation had been seen since.

Physical examination showed a very pale undernourished woman. Tonsils had been removed but part of the right one remained. The mucosa of the mouth as pale and the gums bled easily. The heart, neck, lungs examination was negative. Some rigidity and tenderness were found in the right upper quadrant. The left kidney and spleen were not palpable. A rigid mass could be felt in the right flank. Rectal examination was negative. Vaginal examination showed an enlarged uterus in third degree retroversion. Blood examination showed red cells 4,150,000, leucocytes 14,500, haemoglobin 73 per cent. Blood pressure 150/102-78. Blood chemistry: urea 13.66, uric acid 4.4, creatinine 0.9, non protein nitrogen 33.3. Urinalysis: acid reaction, albumen 2+, no sugar, blood 2+, pus 4+, no casts, sediment a few red blood cells and motile bacilli.

Exam nation of cathet rized bladder urine sho ved  
16 1 leucocytes per c bic m il meter bacillus c h  
but no tubercle bacilli Thalein test sho ed the  
time of app arance to be 5 minutes the first 1  
minut s 35 per ent second 30 minutes 0 per  
cent third 30 m nutes 5 per cent 1 hours 6  
per cent Roentg n ray exam nation of the chet  
was n gatu e Cystoscopic e xamination Ap 14  
sho d bl dder capcity lum ted right ure te al  
orifice normal 1 ft ureteral orifice retr ct d To  
the rght of the left ure teral orifice appeared an r a  
of ulc ration The right s s was cath teriz d but  
it a impossibl to c thetize the left s s  
Exam nation of c thet er ed specimens f ur i c  
sho ed from the bl dter 8 000 leucocytes per cubic  
milli ter fr m th right kid y 2 l uccocyte pe  
cubic millimeter no c ts no orga sms on gram  
mear t rlic c ltures tube cle bacilli T bercl  
b cilli re found n the e m nation of centrifuged  
blai l r u n on April 15 Gun p g i ocul to  
Ap 14 4 fr m the bladder was posit e for tub rcl

bacilli from the right kidney negative for tubercle bacilli Guinea pig inoculation April 6 of urine from bladder was positive for tubercle bacilli from right kidney negative

Operation April 20 left nephrectomy. The kidney showed two large abscessed cavities filled with pus. These were about 3 centimeters in diameter. In the pelvis at the level of the middle calyx was an area of leucoplakia about centimeters in diameter. The epithelium scaled in thin white flakes. At the junction of the lower and middle third was an area of multiple tubercle formation extending from the pelvis clear through to the outer side of the kidney. The ureter was dilated and thickened. The ureteral mucous membrane was studded with miliary tubercles. The abscessed cavities were rigid and thick indicating that the cavities were old. The patient had an uneventful convalescence and was discharged from the hospital May 11 1906.

Diagnosis tuberculosis of the left kidney leucoplakia of the left kidney pelvis

CASE 1. H. S. male aged 41 years single. Patient was seen at the United States Veterans Hospital No. 16 January 30 1913. He had been operated upon some time previously for multiple calculi of the urethra. Venereal disease was denied.

About 5 years before coming under observation he began to complain of frequency of urination burning tenesmus and turbid urine containing flakes. This condition remained unchanged for about 2 years. Some relief was obtained with bladder irrigations. He had passed blood in the urine which he said looked like old clots.

About 3 years before coming under observation he began to have definite cramp like pains in the left loin and flank much burning frequency nocturia and tenesmus. Two years ago he was unable to pass more than a few drops of urine at a time and this condition persisted for 5 days. On examination a large calculus was found in the anterior urethra and later two more were found in the posterior urethra and two in the bladder. The three were removed surgically.

Frequency of urination had been present for 4 years. He was obliged to urinate every 1/2 hours during the day and 3 times at night. He stated that the urine had been cloudy for the past 5 years and had never wholly cleared up. It had been present in the left loin and flank daily for 4 months never extending below the umbilicus. It began about 3 a. m. and persisted until the patient got up.

Physical examination showed that the pupil reacted to light and accommodation. Tonsils were small. Teeth were in good repair. The examination of the neck and lungs was negative. The apex was inside of the nipple line. A slight systolic thrill was heard over the apex and accentuation of the second sound. Examination of the abdomen external genitalia and rectum was negative. Blood chemistry showed urea nitrogen 60 uric acid 2 creatinin 15. Blood pressure was 118-8. The Wassermann test was negative. Roentgen ray exam-

ination showed a shadow in the region of the left kidney compatible with stone.

The urine was straw color specific gravity 1.00 some albumin and some blood no sugar sediment pus 3+ red blood cells 3+ triple phosphates. Thakim test February 8 1913 from the right side time of appearance 6 minutes first 30 minutes 15 per cent second 30 minutes 5 per cent total 1 hour 0 per cent from the left side time of appearance 1 minute first 30 minutes 5 per cent second 30 minutes 0 total 1 hour 5 per cent.

Cystoscopic examination February 10 showed a mild generalized cystitis. The ureters were catheterized without difficulty or obstruction. Clear urine was obtained from the right ureter and thick foul urine from the left ureter. Examination of the urine obtained at the time of the cystoscopic examination showed the following from the bladder and left kidney many pus cells from the right kidney occasional pus cells. Cultures from the bladder and right kidney showed bacillus coli from the left kidney sterile cultures. Albumin was present in all specimens and also red blood cells the right kidney showing 3+. All specimens were negative for tubercle bacilli. Thakim test on March 3 showed 17 per cent the first hour 20 per cent the second hour 37 per cent total for 2 hours. Urograms of the right side showed a normal condition. The left side showed dilatation of the ureter. The kidney pelvis was normal in size but atypical in shape. The calyces were enlarged and irregular in outline.

Operation March 27 left nephrectomy. The kidney showed much retraction and scar formation. The perinephritic fat was dense and adherent. About three fourths inch below the lower border of the kidney there was a stricture of the ureter above which the pelvis was dilated. In the lower pole of the kidney was a large cavity which contained a single stone (Fig. 2 frontispiece). The pelvis and lower pole were filled with a very large stone. The mucous membrane of the pelvis was red swollen and edematous smooth and glistening and showed many small granular spots standing out in marked contrast to the mucous membrane of the superior calyces and lower part of the pelvis. This section of the mucous membrane had a dull china white color. It was smooth without luster and appeared very dull and extended to but not into the large cavity from which the stone was removed. Convalescence after the operation was uneventful.

Diagnosis stricture of the ureter hydronephrosis (infected) stone in the kidney leucoplakia of the kidney pelvis.

CASE 13. T. D. B. male aged 61 years referred by Dr. D. B. Phemister was admitted to the Iresbyterian Hospital January 18 1925. The family history was negative. Six weeks before coming to the hospital the patient had had all of his teeth extracted on account of infection. The patient stated that his present illness began about 35 years ago at which time he had a severe attack of



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d a c l e a r f m t h r g h t s d l d y . R i g h t  
p y e l o g r m h o e l r l r g e h f r o n e p h o s s  
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# SUMMARY

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# BIBLIOGRAPHY

- A L L M J d r o l c 4 4 9  
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## A CONSIDERATION OF CERTAIN DERANGEMENTS OF THE KNEE JOINT

By MAXWELL HARBIN, M.D., F.A.C.S., CLEVELAND, OHIO

F. m. h. Dep't. m. f. g. y. f. th. Lakes. f. Ho. r. i. l. d. h. West. m. Res. C. l. y. s. h. o. l. f. Med.

**D**ISTURBANCES in the function of the knee joint are becoming more frequent and accumulating experience allows us to recognize the disabilities earlier and to offer in most cases definite favorable therapy. The following report of a variety of the conditions is presented in the hope that those cases which may be given beneficial therapy will no longer remain in the group of chronic permanent disabilities to which some of them have been relegated.

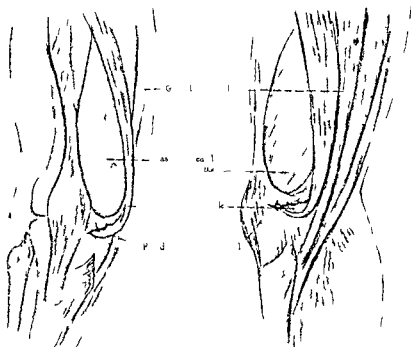
The incidence of certain derangements is largely dependent upon the social environment as for example the industrial hazards or the type of athletics common to the community. In England where football is a more open game displacement and laceration of the semilunar cartilage is more common than in this country. In our larger centers automobile traffic has almost transformed the streets into fields for athletic prowess. The thrust of the bumpers of cars against the legs of pedestrians is producing an increasing number of lacerations of ligaments about the knee joint which may be complicated by dislocation or fracture of the cartilages. Inadequate treatment of these acute cases results in chronic disability referable to the joint. This paper chiefly concerns the management of the acute cases.

In the minds not only of the laity but of too great a number of physicians there is the misconception that limitation of motion or stiffness frequently follows operations of any type upon the knee joint. Sir Arthur Keith states in his foreword to Fisher's (1) book entitled *Internal Derangements of the Knee Joint*. The lay mind still harbors the belief that there are certain disorders of the human body and in this number internal derangements of the knee joint must be included which can be cured only by the application of a manipulative form of magic. There is only one form of curative magic—the application of measures founded on an accurate knowledge of structure, function and disease.

The term internal derangement of the knee joint was first used by William Hey (1803) in his book *Practical Observations in Surgery* chapter VI. Prior to Hey's consideration such disturbances of the knee joint were known to Hippocrates. When Hippocrates states "The bones of the knee are frequently dislocated but they are easily reduced for no great inflammation follows" one is led to believe that he must certainly refer to the same disturbance as Hey using the term dislocation instead of internal derangement. Quoting from Fisher (1) Hippocrates also says "The reduction in these cases is not difficult but in the dislocations inward and outward the patient should be placed in a low seat and the thigh should be elevated though not much. Moderate extension for the most part is sufficient extension being made at the leg and counter extension at the thigh."

Hey states "the joint of the knee is so firmly supported on all sides by tendinous and ligamentous substances that the bones of the thigh and leg are very rarely separated from each other so as to form a dislocation in the common sense of the term yet this joint is not infrequently affected with an internal derangement of its component parts and that sometimes in consequence of trifling accidents the disease is indeed now and then removed as suddenly as it is produced by the natural motions of the joint without surgical assistance but it may remain for weeks or months and will then become a serious misfortune as it causes a considerable degree of lameness. He further states that he is unfamiliar with any previous description of this disease or remedy and then proceeds to give the history and treatment of several cases. True dislocation of the knee is a rare condition and infrequently encountered even in our present day of industrial hazards and automobiles.

Vesalius refers to them as insignificant accidents while Meyer of Zurich elucidated



F d l l C m t f S h m t d t l l t t t l t f t i l m t

clearly the anatomy and mechanism of the disturbance emphasizing particularly the importance of the rotation of the tibia inward and outward around an oblique axis upon commencement of flexion and termination of extension and also how the condyles of the femur rolled upon the curved yielding body of the semilunar cartilage.

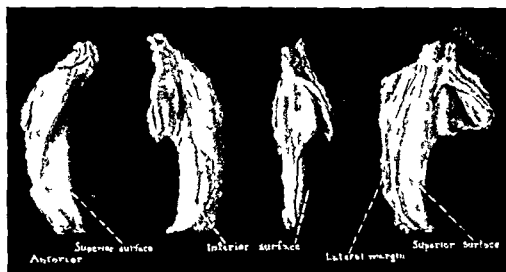
Thomas Annadale in 1885 was the first surgeon to operate upon a patient with disturbance of the semilunar cartilage. He incised a torn anterior end of an internal semilunar cartilage to its original site with an excellent result. The results gained in this case suggested the possibility for relief of derangements of the knee joint by surgical methods and at the same time revealed the pathology which was responsible.

Three hundred years previously Ambrose Pare had successfully removed a loose body or stone from the knee which was classified by him as a monstrosity so that he doubtless

had little conception as to the pathology of such diseases.

Alexander Monroe and John Hunter have both offered theories to explain the presence of loose bodies—the former believing them to be derived from the articular end of the bone while the latter felt they resulted from unabsorbed extravasations of blood into the joint following injury. Sir James Paget suggested the theory of quiet necrosis, i.e. the bodies are sequestra exfoliated after necrosis of injured cartilage with little inflammation.

There is little evidence to support the theories of Monroe and Hunter. Koelliker discovered cartilage cells in the synovial villi and E. Rayney evolved the theory of loose bodies produced from this tissue. Surl and O'good (6) report that Monroe, Hunter and Koelliker between them traced out the three main sources of loose bodies. Koelliker considered the majority were detached by a dissecting osteochondritis.



11-2 Case 3. Internal semilunar til r cartilage of the left knee which illustrates the di placement of the po teri r cornua with the formation of a bulbus tip

William Hey also considered the surgical removal of loose cartilaginous substances from the knee joint. He says although it has often been attended with success yet as the late Medical Society has observed it has sometimes been followed with violent inflammation fever and death itself. It would therefore be of service to mankind could a method be invented of curing this disorder with safety or rendering it of no inconvenience to the patient.

The expressed desire of Hey has been completely realized in our present day surgery. This *bleu noir* was a justifiable one during the pre antiseptic era but not so today.

The hazard of joint sepsis retarded the development of surgery of the knee joint for many years until we find Herbert Allingham (1889) insisted to the profession that with careful antiseptic technique operations on the knee joint are as safe as procedures upon the peritoneal cavity.

**CASE 1 No 110,64** Complete laceration of the internal lateral ligament and posterior capsule of the right knee joint lateral mobility of 30 degrees surgical repair 48 hours post traumatic with return of normal function.

A male steel worker 28 years of age was admitted to the Lakeside Hospital December 19 1915 with the complaint of pain in the right knee. Thirty minutes before admission to the Accident Ward his right lower thigh was struck by the bumper of an automobile. The blow threw him to the pavement. Upon an attempt to use the right leg the pain in the

knee was so severe that he could not walk. The past history was essentially unimportant.

The physical examination revealed a well developed adult male. The heart lungs and abdomen were normal. There were minor lacerations over the knee. A small abrasion in the neighborhood of the lateral side of the right knee was noted. There was slight swelling of the part and a small area of ecchymosis along the medial aspect just beneath the condyle of the tibia. Palpation revealed an area of tenderness on the medial side in the neighborhood of the tuberosity of the tibia. The patella was not ballotable and passive flexion and extension at the knee could be carried out with only slight pain. Lateral mobility of 30 degrees was present. In the extreme position it caused considerable pain and with the knee flexed to 90 degrees the tibia could be displaced forward to a moderate degree without any backward displacement. A roentgenogram of the right knee showed no evidence of fracture.

The urine upon six examinations was normal. The leucocytes ranged between 9,200 and 11,800. The blood Wassermann was negative.

In view of the findings of the abnormal lateral range of mobility at the knee joint a suture of the part was indicated. The part was cleansed with soap water and alcohol and a sterile dressing applied 4 hours before operation. Under gas oxygen ether anesthesia the skin over the right knee was cleansed in the usual manner with alcohol and bichloride and a linear incision 6 inches in length was made over the internal aspect of the knee. It was carried down to the fascial insertion of the sartorius which showed a complete transverse tear in the fascial and the internal lateral ligament together with a portion of the posterior capsule (Fig. 1). The tear extended into the knee joint involving about 1 centimeter of the lateral synovial membrane. The attachment of the sartorius muscle was completely avulsed and the distal portion was folded back between the condyle



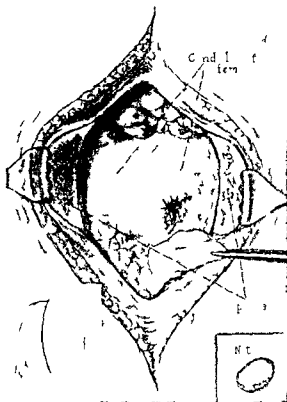
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small hematoma present the attachment of the sartorius was torn the upper portion rested about one inch above its insertion. A complete transverse tear of the internal lateral ligament was present and the attachment of the lateral portion of the internal semilunar cartilage was severely lacerated. The cartilage was excised and the internal lateral ligament was approximated and sutured with No. 1 mattress chromic catgut. The sartorius was sutured with interrupted No. 1 chromic catgut. The leg was encased in a plaster cylinder from toes to groin with 15 degrees flexion at the knee.

The patient made a normal postoperative convalescence the maximum rise of temperature occurred on the first day after admission reaching 39 degrees C. On the third day after operation it reached the same point and descended to normal within 10 days. The wound healed *per primam* a moderate amount of serum accumulated in the joint and was aspirated at 10 days and 4 weeks after the operation.

Physiotherapy consisting of baking and massage was begun 10 days after operation and active motion in the knee was started at the end of 2 weeks. Three weeks after operation the patient was allowed to walk with the use of crutches and he was discharged from the hospital August 30, 1927. Complete weight bearing was allowed at the end of 6 weeks after the operation. At the expiration of 6 months examination of the knee showed 120 degrees of motion. There was moderate thickening of the periarticular portion of the internal aspect at the right knee with about 5 degrees increase in lateral mobility of the right leg as contrasted with the left. Extension was complete and flexion was limited 30 degrees. Three months after operation motion was normal the knee stable and the patient had returned to his former work.

The first case mentioned was among the early ones when the fear of an insufficiently long period of fixation dominated our behavior. However as more of these cases were treated by surgical restitution we began to change our point of view feeling that soft tissues around the knee joint when properly handled should heal as rapidly as elsewhere.

It has been the custom to apply a plaster cylinder from the toes to the groin with the knee flexed 15 degrees for a period of 10 days then a Cabot posterior wire splint for another 10 days. Physiotherapy has been commenced 10 days after operation and active motion without weight bearing 2 weeks after operation under the guidance of a trained physiotherapist. The splint has been discarded at the end of 3 weeks walking with the aid of crutches has been begun at this time gradually



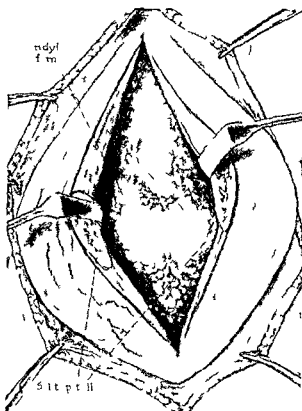
FIG. 6 (left) Case 1. Roentgenogram of the right knee joint which illustrates typical arthritic change together with irregular dense shadows of the loose bodies in the suprapatellar pouch.

FIG. 7 Case 6. Roentgenogram of the right knee joint showing a large hypertrophic spur upon the superior margin of the patella and the shadows of loose bodies in the suprapatellar pouch.

increasing weight bearing until 6 weeks when walking without crutches or apparatus has been allowed. This regime represents a much earlier return to work than our former one of more prolonged fixation and convalescent splinting with a Jones cage knee splint all of which produced an extreme degree of muscle atrophy and to a tremendous degree defeated our aim of a stable weight bearing member. This very important factor is so frequently lost sight of that one cannot refrain from emphasizing it.

The second case is a more recent one and demonstrates an earlier return of function with much less economic loss to the patient and to his employer.

These cases are excellent examples of what can happen following an acute sudden thrust against the lower thigh when the fulcrum is quite close to the knee joint. Although other cases similar in character with the same result might be cited these were considered typical. The pathology demonstrated at operation impresses one with the great importance of immediate apposition of the damaged structures. It is unfortunate that surgical textbooks in particular orthopedic ones either fail to mention the treatment of this disturbance or suggest that a splint be worn for a



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fortnight and the patient should deviate his body weight from the ligament by walking with his toe turned in—if the measures mentioned fail to restore stability the reconstruction of the injured ligament should be considered ( )

The important factor at the outset of such a problem is individualization. If a patient has an injury of the part which has resulted in nothing other than fluid in the joint without an increased range of lateral mobility, a short period of rest followed by physiotherapy will suffice but when the range of mobility is increased 15 degrees over that of the other knee (and this comparison is important because of the tremendous individual variation in the range of lateral mobility) there is necessarily a severe laceration of the ligament if not a complete tear. It is impossible to lay down any hard and fast rule but it would appear in general that such an increase in range of mobility usually is the result of a complete

tear of the structure. When this occurs there is the possibility of interposition of fat or of the fascial insertion of the sartorius as in the previously mentioned case which may prevent nature's producing a sound union. Further there may be damage to the semilunar cartilage which at an early period after injury can only be determined by visualization. This latter disturbance is perhaps of less importance than a knee with abnormal lateral mobility requiring a late reconstruction which at best rarely gives a result so satisfactory as an immediate approximation of the torn structures. Rupture or tear of the crucial ligaments has rarely accompanied the cases which we have encountered. There has been no anterior or posterior displacement of the tibia except in Case 1 where a severe laceration of the posterior capsule occurred and permitted moderate anterior displacement of the tibia. A majority of the damaged crucial ligaments seem to produce no disturbance in function provided that before the part is placed at rest no obstruction to complete flexion and extension is present.

MacGuire (4) following the dissection of several fresh knee joints found that after

severing the anterior crucial ligament hyperextension was definitely limited by the lateral ligaments and posterior capsule. Therefore in the presence of a laceration of the internal lateral and anterior crucial ligaments an early complete repair of the internal lateral ligament produces a stable joint.

We have recently been able to compare the results of four cases treated by immediate suture with a like number subjected to late suture after the patient had walked upon the part for some months. Uniformly there was greater stability in the former group.

It is unfortunate that so many surgeons still feel that the endothelial cells of the synovial membrane have less power to withstand and combat bacteria than have the cells of the peritoneum or pleura. This fear of sepsis by the surgeons has too frequently turned the balance against the patients receiving adequate and rational therapy.

Moorhead (5) reports a series of 49 cases of arthrotomy for internal derangements of the knee joint with primary union in all cases without stiffness of the joint after operation. During the past 35 years we have operated upon 15 cases of the same type with the same result. Moorhead says further: "Certainly no one could ever accuse the profession of having erred upon the side of too frequent surgery of the knee joint as has been the case in many other conditions—it might even safely be said that there has been too great conservatism and the patients have suffered the mistake through lack of education of the medical profession."

In view of the increasing number of these acute joint derangements we should begin to analyze the results of various types of treatment. There has been too great a tendency to resort to mere fixation of the part over a prolonged period without appreciation of the handicaps which have been placed in nature's way of producing a restoration of the lacerated tissues. Those who do not favor immediate suture have contended that the ligament is usually shredded so that adequate approximation and anchorage of the sutures cannot be obtained—thus we have found to be the exception rather than the rule. Usually in our experience the tear is a rather sharp transverse one which is easily approximated.

It is hoped that in the near future a series of these cases will be presented from the Orthopedic Services of two institutions in one all cases with complete lacerations treated by immediate suture and in the other by fixation and apparatus only in such a manner can a sufficient number of cases be compiled. Final examination of both groups of patients if possible will be made by one who has had no part in the treatment so that his impression will be entirely unbiased.

CASE 3 No. 109769 *Displaced semilunar cartilage of the left knee excision of cartilage with complete return of function*

An adult male 65 years of age an official of the Lakeside Hospital was admitted because of pain in the left knee. His previous history was unimportant. Two months before while on a camping trip in Colorado he had stepped down from an elevation of about 12 inches with the left foot the leg was rotated inward. He noticed a sudden sharp pain in the left knee he was unable to stand on the leg for several minutes because of pain. The knee became swollen and during the succeeding week he had seven or eight seizures of acute pain the major portion seemed to be on the internal aspect and several times the knee locked. He consulted an orthopedic surgeon in Denver who first strapped the leg but on account of the persistence of pain and swelling a plaster cylinder was applied. Upon his arrival here 2 days later it was suggested that he wear the cylinder for at least 2 weeks. There was persistent pain in the joint for 1 week during which time he was off the leg. At the expiration of 2 weeks the plaster was removed there was a small amount of fluid in the joint. Crucial strapping was applied and worn for several days a considerable amount of fluid reaccumulated in the joint so that it seemed wise to apply a light plaster cylinder which was worn for a period of 3 weeks. Upon removal of this with crucial strapping the fluid reaccumulated and the pain persisted so that it was thought best to remove the cartilage.

The physical examination showed a well developed and well nourished man whose appearance seemed hardly equivalent to his years. The heart lungs and abdomen were normal. The left knee was slightly swollen. The patella was just ballotable with an increase of one inch in the circumference of the left as compared with that of the right. There was definite tenderness to pressure over the neighborhood of the posterior internal joint space. A complete range of flexion was possible although it produced considerable pain upon the internal aspect of the knee joint. There was no increase in lateral mobility. The blood pressure was 120-75. The urine and blood were normal. A roentgenogram of the knees showed no evidence of pathology.





upon the inner lateral aspect of the right knee joint. This pain remained localized was one that sharp in character and was exaggerated by motion and weight bearing. The knee immediately became swollen and was so painful that his activities were limited. The pain slowly subsided until 1 week before entry when it recurred and forced him to bed. Climbing stairs produced the maximum amount of pain. There was no history of locking.

His past history was rather unimportant. There was no history of trauma except that 1 year previously he had bumped the right knee against the brake handle of a Ford truck, which produced soreness for only 2 days. He was the father of a family of seven children all living and well. There was no history of previous infection. He denied venereal disease.

The physical examination was unimportant except for the right knee which was 4 centimeters greater in circumference than the left. The patella was ballotable. Slight increase in uric acid was present but no redness. Moderate tenderness to pressure existed over the region of the internal joint space with crepitation upon motion. Flexion and considerable pain beneath the patella and was limited about 60 degrees. There was complete extension with no increased lateral mobility. Careful searching failed to reveal any focus of infection. Roentgenograms showed two small calcified bodies in the lateral surface of the joint space with an area of irregularity and decreased density 1.5 centimeters in diameter over the inner condyle of the femur and also a rather smooth shadow of increased density extending from the lateral cortex of the upper tibia below the epiphyseal line. The latter suggested an osteoma. Aspiration of 30 cubic centimeters of fluid from the knee showed a cloudy straw colored rather viscid fluid. A smear showed about eight large mononuclear cells per high power field. Cultures and guinea pig inoculation were negative. An arthro pneumogram was made at this time which showed the hypertrophied infrapatellar fat pad and the loose bodies quite clearly (Figs. 3 and 4). The temperature, white blood count and urine were normal. A diagnosis of osteochondritis dissecans and hypertrophied infrapatellar fat pad was made.

The knee joint was exposed through a patella splitting incision which revealed a rather hyperemic synovial membrane with villus tabs throughout the joint (Fig. 5). A loose body was found free in the infrapatellar portion of the joint about the size of a small butter bean. There was a multiplicity of tabs hanging free in the joint. The ligaments and the ligamentum mucosum were markedly hypertrophied. There was an irregular area of erosion extending about 7 millimeters in depth and 1 centimeter in diameter upon the inferior mesial condyle of the femur. The larger fibrous tabs were excised together with the infrapatellar fat pad. A complete synovectomy was not done. The joint was closed in the usual manner. The patient made a normal postoperative convalescence. The wound healed per primam. Histological examination of the loose body

showed hyaline cartilage and a considerable quantity of white fibrous connective tissue with a fairly massive infiltration of soft tissue by small lymphocytes.

The patient was in the hospital for 1 period of 6 weeks. Physiotherapy was begun 10 days after operation. The patient returned to his work at the end of 1 month following operation and a follow-up letter from him 2 years after operation stated he could not return to the dispensary because of work that he had had no pain or disability in the knee since operation.

CASE No. 115277. Loose bodies in the right knee joint with flexion deformity of the joint, hyperosteoarthritis, exploration of the knee joint, removal of loose bodies, correction of the flexion deformity, complete recovery of function.

A married white female, 50 years of age, was referred to the hospital September 1, 1926 because of severe pain and locking of the right knee. She was perfectly well until 2 years before when a sharp pain appeared upon the internal aspect of the right knee joint. It was distinctly worse upon rising and occasionally kept her awake at night. The knee became swollen shortly after the initial attack and because of this pain she consulted a bone doctor without relief. Later a physician was consulted and treated her with diathermy for several weeks with no improvement. A chiropractor was then seen and manipulated and massaged the part. She stated that there was complete relief for a period of 3 months after which the knee became painful again and up to the time of admission there had been intermittent swelling of the knee. Prolonged periods of rest gave relief. During the preceding 3 months the knee had become locked and the part had become progressively swollen.

Her past history was unimportant except for a case of constipation 2 years before which was treated by enemas. There had been a moderate degree of constipation. Roentgenograms of the thorax at this time showed two suggestive areas of abscess.

The physical examination showed a few scattered freckles, a few hairs on the upper lip, a few average height, somewhat overweight. There were many crowns upon the teeth with moderate periodontitis. The tonsils were atrophic and sore. The heart, lungs and abdomen were normal. The upper extremities and left leg appeared to be normal while there was about 5 centimeter atrophy of the right thigh and calf. The knee was flexed at an angle of 35 degrees from a straight position. Extension beyond this point was impossible. There was moderate crepitation and the patella was placed somewhat toward the outer condyle of the femur. The part showed a moderate genu valgum with thickening of the peritarsal structures especially in the neighborhood of the infrapatellar region and some tenderness in the neighborhood of the suprapatellar pouch. Deep pressure elicited irregular resistance which suggested loose bodies. She was able to walk with the knee flexed.

Roentgenograms of the knee showed hyperosteoarthritis of the joint (Figs. 6 and 7). There



of the synovial membrane scattered throughout the entire joint. The cartilaginous covering of the condyle, patella and tibia appeared relatively normal. The hypertrophic tabs were excised and all of the accessible hypertrophic synovial membrane was curetted. The infrapatellar fat pad was excised. The tourniquet was removed and the wound was sutured in the usual manner. A plaster splint was applied from the groin to the toes with the knee in 15 degrees of flexion.

The patient made a satisfactory convalescence except for a rather high rise of temperature which reached 39.5 degrees C. on the third day after operation. Within 7 days however it had descended to normal. The wound healed *per primam*. Physiotherapy was begun at 10 days after operation. In 2 weeks the patient was allowed up with crutches and was allowed gradual weight bearing until 4 weeks after operation when the crutches were discarded. He was discharged from the hospital on April 1 after a period of 34 days in the hospital.

The histological examination of the tissue showed multiple foci of lymphoid cells surrounded by a deposit of loose connective tissue. Certain sections showed papillomatous processes cut in cross section and richly infiltrated with leucocytes and round cells. The pathological diagnosis was subacute and chronic inflammation non tuberculous in character.

Unfortunately it was impossible for this patient to have physiotherapy after leaving the hospital. His ability to walk gradually increased there was no reaccumulation of fluid in the joint and no pain. In view of the marked improvement in the left knee the patient returned to the hospital July 1927 with a request for the same operation upon the right knee. At this time the left knee showed only periarticular thickening without fluid (Figs 9 and 10) it was painless and there was a range of 75 degrees of flexion.

It is not the purpose of this paper to classify or to discuss the various types of arthritis. It so happens that several of the above cases in which loose bodies were present occurred in patients with an obvious proliferative type of arthritis and so far as terminology shall be spoken of under the rather general name of osteo arthritis in our experience by far the greater proportion of the patients with loose bodies in the knee have osteo arthritis. We are here interested primarily in the surgical aspect of this disturbance realizing that in these cases with advanced bone change it is rarely if ever possible to eradicate the disease completely. In properly selected cases however it is possible to give complete relief while in other function can be tremendously improved.

In all of our cases there has been a definite degree of improvement. A search for the etiology of the osteo arthritic changes was carried out most thoroughly in all cases but since this is primarily a consideration of the surgical aspect etiology was not discussed. One of our most gratifying results occurred in a patient who had been incapacitated for 4 months unable to get around except by the aid of crutches without any use of the right leg because of severe pain beneath the patella upon usage. The roentgenograms failed to show anything other than some atrophy and sharpening of the tibial spines and tuberosities. All previous measures such as physiotherapy and apparatus had failed to give relief with certain misgivings the joint was explored through a patella splitting incision and nothing other than a hypertrophied infrapatellar fat fringe was found to account for the pain. This was excised. It has now been 6 years since operation and the patient reported a short time ago that there had been no discomfort or disability in the knee since operation.

Very little emphasis has been placed upon the frequency with which loose bodies occur in the knees of patients with osteo arthritis further there has been a lack of enthusiasm for their removal. Recently several cases have been encountered where loose bodies have been responsible for a complete disability and their removal has resulted in a complete return of painless function. The period of postoperative recovery has been short the wounds have all healed *per primam* and the stay in the hospital has rarely exceeded three weeks.

The incidence of occurrence of true osteo chondritis dissecans has been very low so that our attention here is largely directed toward the osteo arthritic type. Case 4 showed such slight changes in the joint that it might have been classified as a true osteo chondritis dissecans although the sharpening of the spinous processes was thought to represent a mild osteo arthritis. Senile changes in joints as presented by the roentgenograms are frequently difficult to differentiate from a mild osteo arthritis and the presence of symptoms of osteo arthritis is often the deciding factor. It was impossible in this case to say whether trauma played a part in production of the

body the singularity of the body the lack of visible gross changes in the joint and the fact that within 4 years the patient has had no further trouble would strongly suggest that it might have been traumatic in origin. This loose body was free in the joint quite smooth and ovoid in outline there was microscopic evidence of cartilage and fibrous tissue. Bodies of this type tend to occur in pouches or recesses of the synovial membrane where they remain without change of position they may reach a large size. Because of their tendency to remain in one position they rarely cause symptoms and are often discovered accidentally.

The loose body which occurred in Case 5 probably arose from the cartilage and should be termed a synovial chondroma.

The extraordinary degree of hypertrophic changes in Case 6 are quite striking as well as the early return of satisfactory function. The history is quite interesting the disability extended over a period of 2 years during which time she had practically every form of therapy with brief periods of relief until the deformity plus the discomfort finally forced inactivity. An illustration of the attitude of the medical profession toward surgical interference was brought forcibly to our attention in this case. Shortly before coming into the hospital he had consulted a nationally prominent internist who had advised that if the loose bodies were removed the knee joint would certainly be stiff. There is little necessity for detailed discussion of the pathology in this case since it is a rather ordinary type of hypertrophic osteoarthritis except for the unusual number and size of loose bodies present. Unfortunately the artist was not asked to make drawings of the bodies but an idea of their relative size can be gained from the roentgenographic appearance. Since no definite etiology could be demonstrated at the time for the osteoarthritic change and in view of the numerous synovial tabs it was felt that an early recurrence might take place. It has now been one year since operation and no signs have appeared.

Case 7 is an example of a prolonged disability which had resisted every possible form of conservative therapy. The patient had

become worthless to himself as well as to society and to make matters worse during the course of his discomfort had become a morphine addict following the administration of a few doses by a doctor for the relief of the pain. Both knees presented massive swelling the result of villous hypertrophy with a large amount of fluid while the articulating portions of the joints were relatively normal. It is interesting to note that such a process can persist *in situ quo* for such a long period. There was little choice of therapy since everything except actual removal of the offending synovial membrane had been tried without satisfactory improvement. Further it was not possible to unearth any factor outside the joints which might have been responsible for the disturbance other than the history of an old chronic bronchitis. The blood Wassermann did not seem sufficient and thus the fluid from the knee was tested with a negative result. This case then appeared to be an excellent one for synovectomy at least as a trial procedure upon one knee. Since Keys (3) experimental work upon synovial regeneration we have approached these problems with less hesitancy although as yet we are unable to understand why the regenerated synovial cells should differ from their predecessors in their behavior. A pre-existing focus of infection or disturbed metabolism might produce the abnormal behavior of the cells later to be corrected at any rate before the regenerated cells begin their function. This explanation will not fit all cases and to postulate that there is less tendency for proliferation and hyperactivity of cells following injury is contrary to the physiologic activity manifested in other tissues for when there is demand for repair during the early stages particularly the quantity of cells is usually in excess of the normal requirement. The result in this case was highly satisfactory, the excess fluid and the pain were completely relieved while there was a range of 70 degrees of painless motion. The operation afforded such relief that the patient voluntarily requested the same treatment for the other knee this was carried out only a short time ago and promises a better result than the former operation because of a greater range of motion.

## SUMMARY

The primary purpose of this paper is to emphasize the importance of early surgical correction of complete lacerations of the internal lateral ligament and capsular tears of the knee joint in preference to fixation and apparatus alone. There has been a considerable increase in the incidence of these injuries due to the greater number of automobile accidents. Late repair is rarely so satisfactory as the immediate approximation of the torn structures and further it is the impression that these patients so treated suffer a shorter period of disability. Two representative cases from a group of 16 are reported in detail. An unusual laceration of the posterior cornua of an internal semi lunar cartilage is discussed, the persistent pain even with the part fixed was explained by the position of the torn cornua. Removal of the cartilage gave complete relief.

Several different types of loose bodies in the knee joint are considered their removal resulted in complete return of function. Synovectomy of the knee joint is considered a patient with villous arthritis and hydrops was subjected to this type of operation and satisfactory results were obtained.

## REFERENCES

1. FISHER A G T. Internal Derangements of the Knee Joint. New York: The Macmillan Company, 1914.
2. JONES, SIR ROBERT AND JOYNT, R W. Orthopedic Surgery. New York: William Wood & Company, 1923.
3. KEY, J A. Ref. oration of synovial membrane in knees of rabbits after synovectomy. J Bone and Joint Surg. 1935, vii, 793-813.
4. MACGUIRE, C J, Jr. Acute knee joint injuries. Ann Surg. 1916, lxxiii, 651-662.
5. MCDONNELL, J J. Arthrotomy for knee joint calculus. Ann Surg. 1916, lxxiii, 392-410.
6. SURIS, J K and OSGOOD, R B. Internal derangements of the knee. J Bone and Joint Surg. 1923, v, 635-697.

# THE EFFECT OF IODINE AND THYROID FEEDING ON THE THYROID GLAND

## AN EXPERIMENTAL STUDY

By W. B. MOSSIR, M.D., PHIL. DELP. I.A.  
W. M. H. B. ILLWIS, S. G.

FOR several years we have accepted Plummer's theory as an explanation of the effect of iodine on the course of hyperthyroidism. He believes that the toxic goiter secretes an abnormal substance which has been designated deiodized thyroxin and that iodine exerts its beneficial effect by supplying the iodine radical to this substance.

Recent investigations, however, have cast considerable doubt on Plummer's theory as the following facts attest:

1. The theoretical abnormal substance has not been isolated; its chemical formula is unknown.

2. The theory fails to explain the relapse following an initial temporary improvement when iodine is given to patients with hyperthyroidism.

3. Several observers have demonstrated that the picture of hyperthyroidism can be constantly produced in the experimental animal by intravenous administration of normal thyroxin (3, 5).

4. Administration of iodine has no effect on the course of experimental hyperthyroidism; i.e., there is no effect on the circulating thyrotoxic substance (3, 5).

5. The studies of Keimhoff and Cattell, who took specimens from patients before and after iodine medication, have shown that an involutional change occurs in the gland itself (1, 4).

In view of this evidence it becomes increasingly more difficult to accept Plummer's theory. It is certainly much more logical to assume that iodine exerts its effect at the seat of production of the thyrotoxic substance than on the circulating toxin. It was therefore to determine something concerning the effect of iodine on the thyroid gland under various conditions that the following studies were made:

Adult dogs that had been fed the usual animal house mixed diet for several days were used. During the observation period they were kept on this diet which was varied only by including iodine or thyroid extract. Small specimens were removed from the thyroid gland at the beginning of the observation period at intervals after giving medication and several months after the drugs were discontinued.

**Group 1.** After a section had been removed for microscopic examination the dogs were given iodine in the form of Lugol's solution 10 minims daily for 6 weeks at the end of which time a second biopsy was done. After an interval of several months during which no medication was given another biopsy was done.

**Group 2.** After preliminary biopsy the animals were given thyroid extract in increasing quantities until they exhibited symptoms of hyperthyroidism. A second section was taken. Iodine was then given for 6 weeks at the end of which time a third section was taken. After a rest period of 3 months a fourth section was taken.

**Group 3.** In this group the rotation of drugs was similar to that in Group 2 except that the thyroid extract was continued during the 6 week period that the animals received iodine.

## RESULTS

The histological picture of the specimens removed from different animals after similar rotation of medication showed considerable variation, the most frequent variation being an absence of the typical iodine effect. As a rule, however, the histological picture was similar to that seen in the photomicrograph here presented.

**Group 1.** Figures 1 and 2 are photomicrographs of the low and high magnification of the thyroid gland of a normal dog. Figure 3



Fig. 1

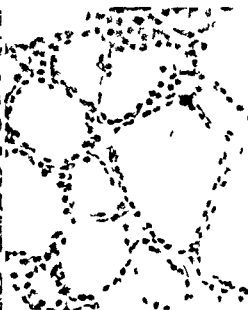


Fig. 2



Fig. 3

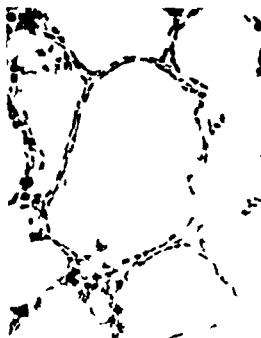


Fig. 4



Fig. 5

Fig. 1 Normal thyroid gland of dog. Low power  
Fig. 2 Same. High power  
Fig. 3 Section from same animal after being fed iodine for 6 weeks. Low power

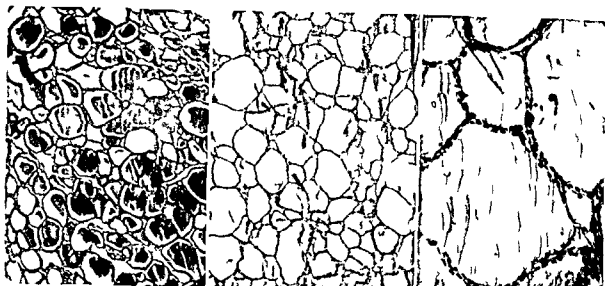
Fig. 4 High power photomicrograph of same section as shown in Figure 3  
Fig. 5 Same animal after a rest period of 5 months. Low power

and 4 are from the same dog after receiving iodine for 6 weeks. As compared to the normal gland it will be noted that the acini are distended with colloid and when seen under higher magnification the cells lining the acini are distinctly flattened. It is reasonable to assume that the ingestion of iodine has produced an increase in the amount of colloid which in turn has produced by com-

pression a very evident distortion of the cells. This condition may persist for a considerable length of time as shown in Figure 5 which is a section from the same animal taken after a rest period of 5 months.

Group 2. A normal section is shown in Figure 6. After receiving thyroid extract for 1 month the sections shown in Figures 7 and 8 (low and high power) were taken. It





F 6

Fig

1 8



1 9

1 10

Fig 6 N m l thy d gl l f d g l p l o S m m l ft f d g th l t t 4 l o S m m l ft L w pow thy l t t  
 Fig 8 S m H g t p o Fig S m H g t p

will be noted that the effect of thyroid extract is practically identical with that of iodine (Figs 3 and 4) i.e. the acini are distended with colloid and the lining cells are compressed. The thyroid extract was then discontinued and iodine was given for 6 weeks at the end of which time a section was taken (Fig 9). This section shows practically no change from that taken after thyroid

medication. In a few of the sections the amount of colloid was slightly increased. All medication was then stopped for 3 months. At the end of this period sections were again taken (Figs 10 and 11). The morphological change in these sections is very striking. When compared to the normal gland of the same animal (Fig 6) there is no similarity of structure. The amount of colloid is greatly

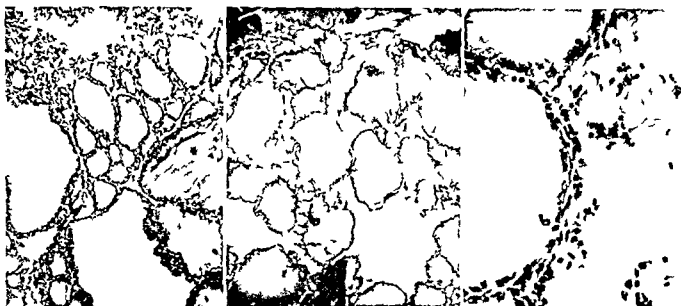


Fig. 1

Fig. 3

Fig. 14

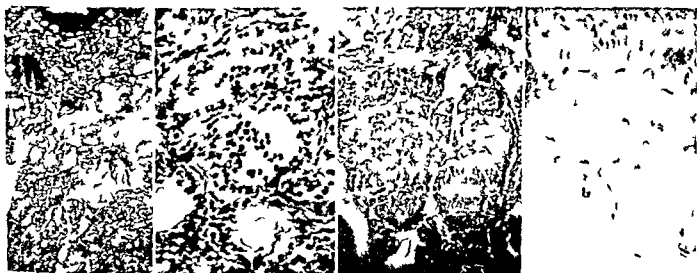


Fig. 15

Fig. 16

Fig. 17

Fig. 18

Fig. 12 Effect of iodine ingestion on a normal human thyroid

Fig. 13 Typical effect of iodine on hyperplastic toxic goiter Low power

Fig. 14 Same High power

Fig. 15 Section showing the effect when the prolonged

administration of iodine has upon hyperplastic toxic goiter Low power

Fig. 16 Same High power

Fig. 17 Effect of prolonged iodine administration on hyperplastic toxic goiter Low power

Fig. 18 Same High power

diminished. The cells are detached and lie free in the acini. Under higher magnification the cells are granular and the cytoplasm is vacuolated. This stage which occurred very frequently after prolonged administration of thyroid extract and iodine was interpreted as a period of exhaustion.

Group 3. In this group the same morphological changes occurred as in the previous group. The stage of exhaustion was identical with that produced in the dogs in Group 2.

*Interpretation of results.* We are justified in concluding from the examination of the various specimens that iodine stimulates the gland to produce colloid. This process continues during the stage of experimental hyperthyroidism. As the colloid increases the cells are compressed and flattened. This mechanical compression may very possibly prohibit at least temporarily the usual secretory function of the cells. After prolonged administration of iodine and thyroid

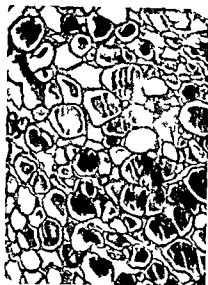


Fig 6



Fig 7

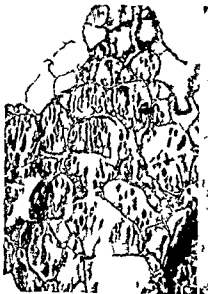


Fig 8

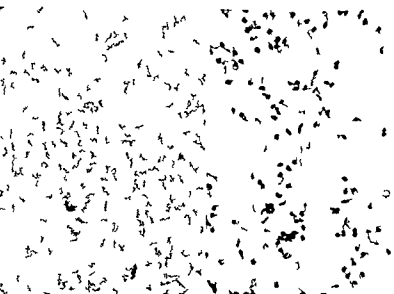


Fig 9

Fig 6 N mlth dgl l f d g Lo po v  
 Fig 7 Sam ml ft f d g thy d t t 4  
 Fig 8 Sm High po

Fig 9 Sm ml ft i g thy i c t t  
 Fig 10 Sm ml ft L power  
 Fig 11 Sm ml ft r tpe d of 3 months

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Fig 12

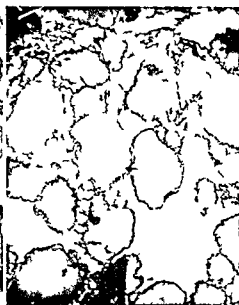


Fig 13



Fig 14



Fig 15



Fig 16



Fig 17

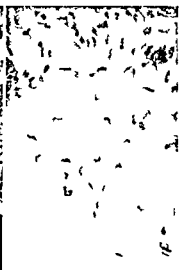


Fig 18

Fig 12 Effect of iodine ingestion on a normal human thyroid  
 Fig 13 Typical effect of iodine on hyperplastic toxic goiter Low power  
 Fig 14 Same High power  
 Fig 15 Section showing the effect of the prolonged

administration of iodine has upon hyperplastic toxic goiter Low power  
 Fig 16 Same High power  
 Fig 17 Effect of prolonged iodine administration on hyperplastic toxic goiter Low power  
 Fig 18 Same High power

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extract the cells become exhausted show change of degeneration and are no longer capable of producing colloid

#### EFFECT OF IODINE ON THE HYPERPLASTIC TOXIC GOITER

The morphological changes produced by the administration of iodine to patients with primary hyperthyroidism have been well described. The acini are usually distended with colloid. The cells are transformed from columnar to low cuboidal and often are exfoliated and degenerated.

It is interesting to note the effect of iodine on a normal human thyroid as shown in Figure 12. The acini are distended and the cells have changed from a columnar to a cuboidal type. The effect is quite similar to that produced in the experimental animal after iodine feeding (Figs 1 and 3).

The typical effect in toxic patients who have been operated upon during the time of maximum improvement is shown in Figures 13 and 14.

The most interesting group of patients from the standpoint of the present study are those who have taken iodine for a prolonged period of time and who have come to operation after they have escaped from its benefit. Microscopic examination of the specimens shows a maximum effect of iodine. The cells are often degenerated, exfoliated and vacuolated. Clinically, however, the patients at the time of operation are often extremely toxic and represent a considerable surgical risk. Figures 15 and 16 (low and high power) are from a patient who took iodine continuously for 18 months. During her pre-operative hospitalization the basal rate dropped 11 points. At the time of operation she was considered a serious risk, although the section shows a maximum effect of iodine. Figures 17 and 18 are from a similar case. The patient took iodine at intervals for several months prior to operation.

If the sections from these patients who took iodine for several months are examined carefully (Fig. 15, 16, 17, 18) a striking resemblance to the section taken from a dog after prolonged iodine and thyroid medication is seen (Figs. 10 and 11). It would seem that

prolonged iodine administration in these patients has produced a stage of exhaustion in the gland similar to that produced in the experimental animal.

Consideration of the facts here presented is I believe sufficient basis for a theory to explain the action of iodine on the toxic goiter. When iodine is first given the cells are stimulated to secrete an excessive amount of colloid. This colloid fills the acini and mechanically compresses the lining cells, thus reducing their secretory power. Less thyroxine is produced and the patient shows clinical improvement. Gradually the cells adjust themselves to the changed condition and resume their secretory power. The amount of thyroxine is thus again increased and the toxic symptoms increase proportionately. Further iodine medication fails to alter the production of thyroxine but does continue to stimulate colloid production. After prolonged iodine administration the cells become exhausted and can no longer produce colloid and on continual iodine stimulation they degenerate. However, even in the stage of exhaustion they are still quite capable of carrying out their pathological function, i.e. production of excessive amounts of thyroxine. The microscopic picture which is usually interpreted as a specific effect of iodine on the thyrotoxic producing properties of the cells is in reality the effect of prolonged and excessive colloid production.

It is an interesting coincidence that De Courcy ( ) from clinical observations has arrived at the same conclusion regarding the effect of iodine as is here presented.

#### CONCLUSIONS

1. In the experimental animal iodine stimulates the cells to produce colloid.
2. Colloid retention compresses and flattens the cells of the acini.
3. The same effect occurs from iodine administration in the presence of experimental hyperthyroidism.
4. Prolonged iodine administration to a hyperthyroid animal produces a stage of exhaustion in the gland.
5. The effect of iodine on the normal gland is similar to that in the animal.

6 The effect of iodine on the hyperplastic toxic goiter is similar to that obtained in the normal gland of the dog.

7 After prolonged administration of iodine (3 to 1 months) to the patient with hyperplastic toxic goiter a stage of exhaustion is noted. This is similar to that produced in the animal by prolonged feeding with thyroid extract and iodine.

8 The clinical status of the patient is not proportionate to the histological picture

when iodine has been taken for a prolonged period.

9 A theory to explain the action of iodine in the patient suffering with hyperthyroidism is presented.

#### REFERENCES

- 1 Cattell R B Boston M & S J 1925 cxvii 989
- 2 D Courcy J I Ann Surg 19 7 lxxvii 871
- 3 Kunde M M Am J Physiol 192 lxxvii 103
- 4 Reinhoff W F Jr Bull John Hopkins Hosp 1925 xxxvii 28
- 5 Sturgis and Badger J Clin Investigation 1926 ii 289

## MORPHOLOGICAL CHANGES IN EXOPHTHALMIC GOITER FOLLOWING THE USE OF LUGOL'S SOLUTION

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IT is now generally recognized that in every case of Graves' disease the thyroid gland shows constant pathological changes. Many authors agree that the microscopic picture runs parallel with the clinical course. When Plummer proved that the administration of Lugol's solution was followed by a striking remission in the toxic symptoms, a search was at once begun for an anatomical basis for this fact.

Rienhoff, Cattell and Giordano in this country and Merke in Switzerland concluded that after iodine medication the exophthalmic goiter shows such a high grade of involution that it resembles the normal gland or colloid goiter. In seven cases of severe exophthalmic goiter Rienhoff removed a portion of the gland before any medical treatment was given and compared it with the gland which was later resected after the administration of iodine. Merke likewise made a comparison of tissue removed from the same gland before and after Plummer's treatment, but his first excision was combined with ligation of two or more thyroid arteries.

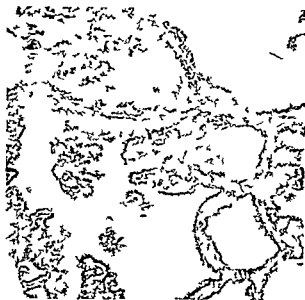
Rienhoff's method is ideal if he succeeded in making the first excision without ligating any of the thyroid arteries. It is difficult to understand how he could remove a large portion of the gland including the whole upper pole without interfering with the blood supply. We

know that ligation of the thyroid vessels causes changes similar to those described by Rienhoff. This being the case it is necessary to use great care in drawing conclusions from such methods. Another source of error that must be taken into account is that the same exophthalmic goiter may show entirely different microscopic pictures in various portions of the gland.

In our study we examined slides from 30 patients who had not received Lugol's solution prior to operation and from an equal number of patients who had been given Lugol's solution before operation.

The first series was studied to establish a basis for comparison. All of the cases presented the complete clinical picture of Graves' disease, but the duration and severity of the clinical symptoms varied. In the second series in which Plummer's method of treatment was used, various grades of toxicity were present so we did not follow Giordano who selected for comparison only the thyroid glands of patients dying during thyrocrisis.

Most authors make a sharp distinction between primary and secondary exophthalmic goiter. The expediency of this division is questionable. From my own studies not alone of these 60 glands but also of many glands from patients of European extraction I am forced to the belief that exophthalmic goiter



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develops usually in a diffuse colloid goiter. In 54 per cent of the glands in my first series the patients had not received iodine and the glands did not present the classical diffuse meaty dry appearance on the cut surface but were amber red and translucent either throughout or in patches here and there suggesting a colloid rich tissue. In nearly 85 per cent of the glands groups of lumina could be



Γ b 3 Γ hth lm g t f c p III Du t f  
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 y m th Th l l p t th type f l l prolif m  
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 l th lm g t l l n w d p l y m  
 ph t l f l d h f th l l l h d l d t  
 Th f f m l l l

distinguished with the unaided eye. These lumina represented large colloid containing follicles such as one never sees in the normal gland but which are characteristic in the diffuse colloid goiter. Even in glands with uniform dry meaty cut surface these lumina were seldom missing.

Likewise the distinction usually made clinically between innocent colloid and exophthalmic goiter does not seem to be justified since the diffuse colloid goiter at least the proliferating form is often associated with slight symptoms of hyperthyroidism. In his treatise



Γ g 4 S l l ty f f p th l m g t C p IV  
 y rs d t t f od P t t 6 l l l l f 3



FIG. 5. Section from exophthalmic goiter removed 15 months from a girl 15 years old who had not received the Plummer treatment. We find the transitional stages from colloid to exophthalmic goiter: large round follicles, narrow ducts and solid areas. The acini appear empty.



FIG. 6. Exophthalmic goiter removed after 13 days of the Plummer treatment. The goiter belongs to Group I. The large acini are filled with well-stained colloid.

on diseases of the thyroid gland Hertzler mentions that he often saw slight toxic symptoms in young people who were developing colloid goiter and in his recent article on classification of goiters he brings out clearly the relationship between colloid and exophthalmic goiter.

From their microscopic appearance the glands of our first series can be grouped in four different stages of hyperplasia.

**Group I.** Diffuse colloid goiter with marked epithelial proliferation (Fig. 1). The 9 cases which belonged to this first group had toxic symptoms only a short time or only in a moderate degree of severity. Microscopically the acini of these glands were much larger than were those in the normal gland and were extremely irregular in form because the epithelial wall extended into the lumen. These elevations of the wall were covered by a high epithelium with slender crowded nuclei which stained deeply while the remaining circumference of the follicle still exhibited a cuboidal epithelium. The colloid was markedly diminished in amount and altered in quality. The normal eosinophile refractive material was replaced by a very pale staining vacuolated substance. In two cases the content of the acini had not taken any stain and the lumina appeared empty.

**Group II.** The second stage of development of the lesion. The acini in the four glands in

this group were narrower and still more polymorphous than were those in the first stage because the elevations and foldings of the wall were higher and abundant. The epithelium of the whole circumference of the acinus was columnar. Beneath the epithelial lining of

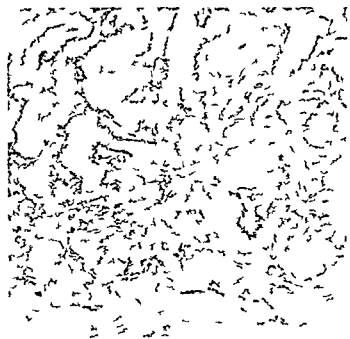


FIG. 7. Exophthalmic goiter removed after 12 days of Plummer treatment. Colloid filled with acini marked by epithelial proliferation of the wall. Belongs to Group III.





Fig 3 Sll phthlm gt faye d t  
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 f the mll t n wll t d cll d fo d

the projections a closely packed mass of epithelial cells was seen with many capillaries. These solid cell groups could be traced to the epithelial lining by diverticula budding from the wall (Fig 3). In the e which were at first solid masses small acini form by separation of cell groups which in my judgment is the most common way of producing the formation of new follicle. It is the same process which Sanderson described in the normal adolescent gland and which is found often in the diffuse colloid goiter. By this new production of cells secondary lobules are formed the peripheral cell masses of which are descendants of the epithelial wall of a large acinus. The lumina become more and more narrowed until a branching elongated duct results. These irregular duct like forms of the acini in the exophthalmic goiter caused Klose Zander and others to hypothecate their origin from the central canaliculi of the embryonal thyroid gland. I believe on the contrary that these ducts are not the origin but the final product of the epithelial proliferation.

Group III Exophthalmic goiter (Fig 3). The e were 8 glands in which the epithelium predominated and which on the first glance appeared as solid masses of cells. With higher magnification very small acini could be seen surrounding ramifying long narrow ducts. These were regarded as rests of the former wide lumina of the colloid goiter. The acini appeared empty or their content faintly acic dophilic looked ragged and granular.



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 d s f Pl mm t tm t All k d ft t l tag  
 f om th ll d t th phth lm gt ry  
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Group IV Solid type of exophthalmic goiter (Fig 4). The solid type of exophthalmic goiter was seen in even of our cases. Clinically they did not as in Pienhoff's opinion represent acute very severe cases of Grave disease but the toxic symptoms were of long standing. All made a good recovery after operation. In the only acute case in our series in which the outcome was fatal the patient died without operation and belonged to the second group.

Generally Group IV is distinguished as solid or glandular—in contradistinction to the papillary type. We consider these solid glands the final stage in the development of exophthalmic goiter and not an entirely different type of goiter because we find here and there in sections of solid exophthalmic goiter the same long duct like acini we find in the other groups.

In one third of the glands it was difficult to determine the exact stage of development because their microscopic picture was so varied. Different portions taken from the same gland and even different areas in the same microscopic section may show different stages of epithelial hyperplasia. In Figure 5 all kind of transitional stages are present: the wide round follicle of the quiescent colloid goiter, the irregular acini of the papillary form and the solid tissue of the glandular exophthalmic goiter. The focal nature of the alterations in

the thyroid may be recognized in the fresh cut surface of the gland by the opacity and granular surface of the altered areas in contrast with surrounding colloid rich tissue (21 per cent of our first series). It is difficult to understand why the lesion should appear thus in certain areas only involving a great number of alveoli or only a few follicles. It is necessary, however, to keep these facts in mind in studying the pathological changes found after Plummer's treatment.

We made a study of the glands in 30 patients who had exophthalmic goiters and who had received Lugol's solution from 3 to 10 days before operation. The gross appearance of these glands requires a brief consideration. Rienhoff was struck by the vast difference between the thyroid glands in patients treated with iodine and in those in which iodine had not been given. In the former the gland seemed to him to be quite definitely increased in size and harder in consistency, the capsule was thickened and seemed to bulge with the contained lobulated parenchyma. On incision he found the gland in certain areas more resistant to the knife, the lobulation being more pronounced. The cut surface was glairy and showed small cyst like areas suggesting beginning adenomata which were full of fluid resembling colloid. The glands of our second series did not show any striking difference in their gross appearance as compared with the glands in which iodine was not given. Seventeen per cent of them had a glairy translucent amber red cut surface but this was noticed also in 16 per cent of the first series. In about the same percentage as for the glands taken from unprepared patients, namely in 83 per cent the lugolized glands presented typical gray meaty parenchyma either uniform throughout the cut surface or only in numerous irregular patches. Cyst like lumina were found in 74.8 per cent of the glands of patients receiving iodine and in 84.8 per cent of the glands of patients who did not receive iodine.

#### MICROSCOPIC FINDINGS

Rienhoff describes the acini as wide ballooned of regular form and size. We expected to find after Plummer's treatment only glands belonging to our Group I. But we had to classify our microscopic findings in the same four

groups with about the same percentage as in our first series. Twelve cases of our second series belonged to Group I (Fig. 6), 3 to Group II, 7 cases represented the third (Fig. 7) and 8 the fourth type of our classification (Fig. 8). Considering the size of the follicles and the amount of solid parenchyma we were not able to notice any striking difference between the two series. We believe that the size of the acini depends on the stage of development of the lesion and we must not compare pictures of different developmental stages as apparently Rienhoff did (Fig. 9).

Rienhoff noticed in the glands removed after iodine treatment the enormous increase in the fibrous connective tissue disseminated very irregularly throughout the gland. There was in his judgment a true sclerosis of the glands. With the exception of a single instance not any of the thirty glands showed such a sclerosis. There was no difference in the amount of connective tissue in the glands of the first series as compared with those of the second. It would be very difficult to understand how in a few days this fibrosis could develop. The only case in my series with septa larger than in the normal gland was one which had received several X-ray treatments which may have been the cause of the increased stroma.

The blood vessels and lymphatics were much less evident in Rienhoff's cases after Plummer's treatment being collapsed by the pressure of the distended acini. Cattell too saw a decrease in vascularity according to him caused by endarteritis. We are not able to corroborate any of these observations. With A. Kocher we believe that it is nearly impossible to estimate the vascularity of the living gland from the appearance of the microscopic sections. The amount of blood in the capillaries depends on the succession of ligation of the blood vessels. There will be congestion if the veins have been ligated previous to the arteries, anemia if the arteries have been first ligated. It is likely that Rienhoff removed the sections for biopsy without ligation and made the resection of the gland after ligation of the thyroid arteries. The capillaries were in both of our series very well filled and no difference could be noticed. I was unable to corroborate Cattell's description of endarteritis.

In Rienhoff's material the lymphocytic infiltration was much less pronounced than in the cases in which Lugol's solution had not been given and the areas that were present seemed to be markedly reduced in size. In our first series in which iodine was not given we found glands without 5 with few and 23 with many groups of lymphocytes. In the gland removed after Plummer's treatment we found 10 glands without 7 with few and 13 with abundant lymphocytic infiltration. This would mean a slight but distinct difference between the two series. By far the most pronounced change which Rienhoff observed after iodine medication was in the appearance of the colloid. It was abundant distended the acini to their capacity and stained uniformly throughout. In some glands Rienhoff saw large colloid cysts and localized areas of very much dilated acini encapsulated with compressed parenchyma indistinguishable from the so-called adenomata which in his opinion developed during the Plummer treatment.

If we discard one case which received Lugol's solution for only 3 days we found in 84 per cent of the glands removed after iodine medication a definite change in the amount and consistence of the colloid. Not only the large follicles but also the small ones were filled with a refractive evenly and deeply stained substance. Compared with sections of glands removed without iodine medication this change of the colloid is so definite and so consistent that we feel justified in regarding it as the result of the iodine medication.

However we must not overlook the fact that in 16 per cent this change was missing and this was true not in patients as Giordano and Cattell believed without clinical improvement but in patients who showed a definite remission of the toxic symptoms after administration of iodine. The problem is still more complicated by the fact that one gland had thick colloid but there was no clinical improvement.

In 100 per cent of the glands of our first series the colloid had a thick consistency although we are sure that the patients had not received any iodine in the hospital. Still we have the suspicion that these cases received iodine in some form before entering the clinic. One patient admitted that he had taken medicine

at home another was treated by an internist after the Plummer treatment was generally accepted by the profession. Two of the cases in which thick colloid was found throughout the gland died a short time after the operation of an acute thyrotoxicosis. These patients were not regarded as bad operative risks and were prepared only by a short period of rest 2 and 5 days respectively. We are wondering if these patients did not receive iodine before admission to the hospital and thus simulated a mild case on account of a regression of the toxic symptoms. Lahey called attention to the danger of giving iodine without the knowledge of the surgeon thus making it impossible for him to recognize the severity of the disease.

In two patients in our first series who had received bromides for 12 days well stained refractive colloid was present in the gland. This can be explained perhaps by Fellenberg's analysis of the officinal salts of bromide which contain a considerable amount of iodine.

Less evident and only secondary to the quality of the colloid were the changes of the epithelial cells after administration of iodine. The columnar form of epithelium prevailed in 42 per cent of the iodulized glands as compared to 59 per cent of the unprepared. Cuboidal cells were found in 55 per cent of the glands removed after Plummer's treatment and in 40 per cent of the controls. In 38 per cent of the glands of the second series many high papillations were present as against 70 per cent in the first series.

Still less marked was the difference in the desquamation of the epithelial lining of the acini between the glands removed after and those without iodine treatment. Twenty four of the iodulized glands showed pronounced desquamation as compared to 33.3 per cent in the first series.

Rienhoff on the contrary found the majority of acini lined with flat cuboidal cells which seemed inactive and shrunken. The nuclei were pyknotic and no acini were filled with desquamated cells.

#### SUMMARY

Thirty exophthalmic goiters removed after Plummer's treatment were compared with

thirty glands removed without previous iodine medication. Most of the observations described by Idenhoff could not be confirmed. After Plummer's treatment no changes in the vascularity and in the amount of fibrous tissue were found. The acini were not round, smooth-walled and of regular size and form. Neither was the epithelium flat, cuboidal nor were the nuclei small, irregular and pyknotic. A formation of adenoma-like tumefactions and colloid cysts visible with the unaided eye did not occur in our material. In 84 per cent of our glands removed after Plummer's treatment the only definite difference as compared to untreated cases was found in the appearance of the colloid. The acini of these glands had more and higher concentrated content in spite of the fact that the hyperplastic character of the glands was not altered.

These findings corroborate Albert Kocher's observation that most of the Basedow glands removed after iodine medication show distinctly more stained colloid than those without.

Therefore if we regard the liquefaction of the colloid as the most characteristic feature of the exophthalmic goiter, we doubt that the change in the amount and quality of the colloid which follows Plummer's treatment explains the clinical improvement completely. The fact that in our material four cases improved very well on Lugol's solution but did not show thick colloid in the glands and that one case did not improve on iodine but had a gland rich in concentrated colloid suggests that this problem is much more complicated and will not be solved by the anatomical method alone.

## NEWER ASPECTS OF LIVER DISEASE<sup>1</sup>

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ABOUT a hundred million years ago biologists tell us cells began to succeed better in life's battles by joining together for the common purpose of finding and assimilating food. Since then there has developed a progressive specialization of the cells in multicellular organisms to an extent that is seldom realized. The interdependence of the cells has become such that none is able to live alone. In fact, one of the triumphs of modern science has been the artificial restoration of conditions approximating those of life close enough to permit such survival. This specialization has become so extreme that most cells have but one function: gland cells excrete for the most part specific substances such as mucus, thyroxin; skin cells only make their contribution of keratin and die; others conduct nerve impulses. The whole life of the majority of our cells is of this type. They are mere machines which perform very limited functions and have to be fed and cared for as well as controlled by other less differentiated cells.

It is as such a mass of undifferentiated cells that we may look upon the liver. We used to hear a good deal about the function of the liver. Much searching for specific functions was done with but little result. A few years ago the word glycogenesis would have pretty well summed up our ideas on liver functions. Now we know that it is concerned in nearly all fundamental vital processes and its functions are manifold. We should then look on the liver from the opposite standpoint. It has no function necessarily to serve other cells. Other organs serve it. It is really the liver in a punning sense. It merely lives as an undifferentiated set of cells which have withstood the tendency to specialization and are concerned mainly with the most fundamental physiological process, the assimilation of nutrition.

With this biological conception in mind, let us turn to a matter which has been of supreme interest to modern biologists and which makes up a large share of the general biological literature of the day. I refer to cell permeability.

in relation to the mineral salt content. It has been demonstrated by a very large number of workers that the concentration of the ions of calcium as opposed to those of sodium and potassium has a very delicate balance which has to be maintained with great exactitude in order to support life. If the number of calcium ions in the media is increased there will be a so called "freezing" of the cell and it becomes impermeable. It is no longer able to pass material in and out of its cell membrane, no food is absorbed and it passes into a quiescent state. If the sodium or potassium ions are increased the opposite takes place. Permeability is increased, activity of all sorts is hastened and if the process is carried too far cell dissolution takes place and it falls to pieces from too great permeability of its covering membranes.

Bearing these points in mind we will now discuss the clinical aspects of liver disease as seen by surgeons. These may be classified under three headings: (1) parenchymatous degenerations due to obstruction of the bile ducts; (2) similar changes of lesser degree following ether or chloroform anaesthesia; (3) hepatitis, inflammatory degenerations due to infection from the gall bladder or other foci in the portal circulation. In the same general category on the medical side are cirrhotic diseases, eclampsia and anaphylactic shock.

This entire group are marked by a peculiar train of symptoms, vague but none the less definite. The group is characterized by falling blood pressure, slowing of the pulse (except in the more acute cases), itching disturbance

unless it is counteracted by glucose injections. Urea formation ceases, uric acid is increased but not to toxic levels as it is rapidly excreted. The amino acids in the blood are increased but also not to toxic levels. These are the only changes of any possible significance noted in such animals but nevertheless the animals all die in a few hours and the cause of death is utterly unknown. However it is certainly not anything like what we miscall hepatic insufficiency in the clinic.

For a long time it has been supposed that in jaundice and other liver diseases the toxic agents were the bile salts, salts of taurocholic and glycocholic acid. To them was attributed the itching, renal irritation and albuminuria, falling blood pressure, etc. Recently Rown tree and Greene have made a brilliant series of studies on this subject which appear to be conclusive and to prove that there is no relation between the concentration of bile salts in the blood and the symptoms of jaundice and hepatitis. Increased bleeding time, itching and jaundice are all shown to occur both with normal and with increased bile salt concentration and the injection of the salts into animals far beyond any amounts met clinically fail to produce these symptoms.

Amino acids as a cause of toxemias have been studied by Neuman and Marsh with the result that they too can be ruled out completely as a cause of toxic phenomena. Amounts varying from two to four grams per kilo were injected and in none of them except histidine was any toxic effect evident. These amounts are overwhelming compared with

and they have proved that these substances do not occur in amounts large enough to be toxic.

The evidence then is so far entirely negative. We can say with assurance that the cause of the symptoms of jaundice etc. is not bile salts, bile pigments, not glycogen starvation, not polypeptides, not amino acids. There is not much left. Still these symptoms do occur and they must be due to some toxin arising in the liver as they are absent after hepatectomy.

Our first lead along this line arose from the work of Mason. He recently published the fact that if small amounts of liver were cut off and dropped back into the dog's abdomen a rapidly fatal toxemia ensued. A few grams were sufficient to cause death within 18 to 24 hours. In his animals the toxemia was marked by a fall in the concentration of the serum and plasma, increased coagulation time, increased fibrin in the blood, and increased uric acid.

These experiments have been criticized on the assumption that this procedure killed the dogs by producing a peritonitis, but we have repeated them, inserting the bits of liver into the chest and into the axilla and have had the same results. Mason thought that the toxic fraction was in the non-protein nitrogen fraction but the results are not positive.

It is obvious therefore that there is a substance in the liver which can cause severe toxemias, and with this in view we undertook a study of the liver proteins as they seemed to be the only substances not yet accounted for. In the first place in some experiments already reported by Peterson and Andrews it was shown that in totally eviscerated animals injection of large amounts of bacillus coli toxin which ordinarily causes a heavy albuminuria had no such results in the absence of the liver. Shock, chills, and fever ordinarily provoked by such injections were conspicuous by their absence. This finding seemed an additional evidence that some liver protein was at fault.

#### EXPERIMENTAL

The proteins in the urine of dogs with hepatic disease were studied immunologically by the following method. The common bile

ducts were tied and the urine collected twice daily in the studies on obstructive jaundice. In those on ether toxemias female dogs were catheterized deeply, intoxicated with ether for 3 hours, and samples of urine taken every few minutes. In each case the earliest samples showing albumin were saved and the proteins studied.

Antisera were prepared against dog blood by the method previously described by us, which would react to dog blood in dilutions of 1:1,000,000. Next dog livers were perfused until the perfusate was protein free, ground and extracted, and antisera prepared which were sensitive to 1:100,000 against dog liver. Of course the liver antiserum was also highly potent for blood, as it is impossible to wash the blood out of the liver. In both the jaundiced and etherized animals the early specimens of urinary protein gave reactions in high dilutions to liver antiserum and none to blood antiserum. This may be regarded as positive evidence that this urinary protein originated in the liver. In later specimens there also followed the excretion of large amounts of blood protein.

Next studies of the mineral salt content of normal and pathological livers were undertaken. These results are being published *in extenso* elsewhere, but we may say here that in dogs in which the common bile ducts have been ligated and severed there is a profound fall in the calcium in the liver. Normal dog livers analyzed in our laboratory have a calcium content very close to 22 milligrams per gram of dried substance. In jaundiced animals it falls to 180 to 170 milligrams. This represents a change which *per se* without assuming any toxemia is sufficient to bring about a disintegration of cells and a leakage of the normal cell contents into the circulation. While there is but slight variation in the potassium contents of such livers, the increase of the sodium ion is enormous and amply accounts for the cellular dissolution which microscopic studies show to take place.

#### DISCUSSION

It is well known that proteins that are foreign to the blood are promptly excreted by

the kidney. This has been shown to be true for egg albumen and serum proteins of other species. In our laboratory it was demonstrated by MacDonald in experiments bearing much more closely on this problem. He injected a mixture of dog blood and liver proteins into dogs and found that the blood protein was held back and the liver proteins were excreted in large amounts.

What then is the mechanism of this albuminuria? It is clear that for some reason as we have shown protein passes from the liver and makes its way into the blood where it is excreted as foreign protein. Why does it leave the liver? It is in all probability bound up with change in the permeability of the liver cells due to a disturbance in the mineral salt balance which I discussed earlier in this paper.

In a recent communication one of us suggested that in uræmia such a mechanism was acting. The recent use of overwhelming doses of calcium as employed by Walters and others in the treatment of jaundice is a striking confirmation of this theory especially as the clinical results have been found to be so excellent.

## CONCLUSION

1. A protein from the liver is passed in the urine in the early stages of certain hepatic diseases.

2. This leakage of protein from the liver is due to a disturbance of the mineral salt balance.

## BIBLIOGRAPHY

- ANREW E. IRTERSON, W. F. and B. AAN W.  
Obs. at o. ev. sc. tel. d. g. Proc. S. Eq.  
Bi. l. & M. d. 19 7 109  
ANREW I. T. IA W. A. S. c. fu. rv. pro.  
t. n. l. c. Soc. I. pe. B. l. & M. 1927 x.  
3. I. l. m. J. Am. M. A. 9 8 c. 539  
4. I. l. t. l. J. Am. M. A. s. 927 l. c. 99  
5. MACDONALD K. I. Tit. IAS. W. A. l. l. E. AS  
E. P. c. Soc. F. per. B. l. & M. d. 19 8 246  
6. MASO I. C. t. l. St. dy. of. t. e. t. l. y. m. i.  
J. Lab. Cl. M. l. 19 5 62  
7. N. S. UR. H. I. H. nd. Ma. s. I. P. IL. H. R. l.  
J. I. om. m. a. d. Ar. h. I. t. Med. 9  
68  
8. R. A. N. RE. L. G. CRE. N. C. RL. H. AND. ALD.  
MARTIA. Ou. t. t. t. I. t. k. fic. lu.  
blood. et. J. Cl. I. t. 9 7 v. 545  
9. T. I. O. S. W. A. Sc. LEG. L. KAR. A. DRE. E.  
P. p. rat. n. f. blood. fre. u. n. y. pr. t. s. Arch.  
Int. M. d. 923 l. 444  
10. WIL. AS. N. C. l. M. NV. I. H. p. t. f. ct. lm. J.  
hl. fo. m. d. pho. ph. s. p.  
I. hy. l. 9 3 l. 67

## CANCER OF THE CERVIX UTERI

ITS SURGICAL TREATMENT AND CRITERIA ESSENTIAL TO THE ESTABLISHMENT OF A PROGNOSIS FOLLOWING OPERATION<sup>1</sup>

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FROM a review of the literature of the past few years one might well conclude that surgery in so far as it has been applied to cancer of the cervix uteri is wellnigh *passé*. The almost hysterical rush of many of our foremost American and European colleagues to forsake surgery for the charms of radiotherapeutic measures is sufficient to arouse more than passing interest. Indeed the stampede to radiotherapy immediately warns us that all is not well with surgery as it concerns cancer of the cervix uteri.

One notes with concern the formation of well defined groups of protagonists those favoring surgery only in apparently operable cases of cancer of the cervix uteri those favoring radium and deep X ray therapy as the only remedial procedure in all cases and happily a third group who realize that there probably is virtue in both procedures and are trying to solve the problem in a quiet deliberate and unbiased manner. It is from the latter group that we will ultimately obtain information of permanent and constructive value. Such observations require a period of 8 to 10 years in clinics where the work is carried on by a small group of competent individuals according to a well formulated plan which should include the collaboration of one versed in pathology so that tissue correctly obtained as well as properly fixed cut and stained may be studied and filed away for future reference.

Argumentation and partisanship rarely lead to correct scientific deduction indeed they tend to obscure one's vision and defeat the purpose of investigation which is merely the ascertaining of facts whatever they may be. The purpose of this paper therefore is not to present surgery as applied to cancer of the cervix uteri in a light which may appear to belittle other therapeutic agents rather we propose to analyze critically some phases of

cervical cancer treated by surgery in order that we may more fully appreciate its advantages as well as its limitations and the cause thereof. In a similar way we may also obtain a more accurate method of comparing results in patients treated with radium and X rays.

A consideration of surgery as properly applied to cancer of the cervix uteri involves two factors first a proper selection of patients for operation and second an adequately performed operation by one experienced in this type of surgery.

## SELECTION OF PATIENTS FOR OPERATION

What constitutes the borderline between operable and inoperable cancer of the cervix uteri is in a large measure a matter of individual interpretation. A study of the material from 290 patients who were operated upon at the Johns Hopkins Hospital prior to the year 1910 as well as studies in other clinics has yielded some definite criteria to govern us in deciding clinically whether or not a given patient comes within the scope of operability. By operability is meant that the condition is such that on the basis of experience a permanent cure may reasonably be expected.

Extension of the cancer to the rectum bladder or paracervical tissues in our experience and the experience of numerous others precludes the possibility of a permanent cure. If the cancer extends on to the vaginal wall to a point which makes it impossible to remove the growth and still leave a macroscopically normal margin of at least centimeters local recurrence will almost inevitably follow. Regional lymph gland involvement and ureteral obstruction originating in the cervical parametrium in our experience likewise prevent permanent cure by operation. Occasionally a patient with the first complication may live as long as 8 to 10 years before recurrence proves fatal.

Another factor of importance in helping us



to determine whether a patient should be operated upon is the length of time she has had the neoplastic disease. The history of the duration of the symptoms of bleeding or of normal vaginal discharge will help to determine this point although obviously such a determination is crude and inaccurate. However from the experience gained at the Johns Hopkins Hospital it would seem that in the epidermoid variety of cancer a history of symptoms of more than 8 months duration is in itself generally sufficient to put the patient beyond the hope of cure from operation no matter what the pre-operative clinical findings have been. Unquestionably there will occasionally be an exception but it will probably be safer to accept this rather than most clinical generalizations.

It is essential to determine clinically before operation whether all of the foregoing contraindications to surgical intervention exist. It is possible by bimanual vaginal and rectal examinations vaginal rectal and bladder visualization as well as pyelography to determine all of the foregoing factors except two namely regional lymph gland and parametrial extension of the disease. It should be stated too that if the neoplasm has not actually involved the bladder mucosa it is difficult to interpret accurately the bladder findings by means of the cystoscope.

If by any chance the patient is so emaciated that the exploring finger in the pelvis detects palpable and adherent iliac or obturator glands then the local process is so well advanced that it is manifestly not wise to operate. Generally gland involvement cannot be determined before operation.

The clinical determination of involvement of the cervical parametrium however presents a most important and as yet rather insurmountable obstacle to the accurate clinical appraisal of the neoplastic dissemination. If the uterus is fixed and the vaginal vault and cardinal ligaments are densely hard the inference of paracervical infiltration is most cases is obviously correct. However if the uterus presents questionable if any fixation slight induration of one or both lateral vaginal fornices and moderate or slight but nevertheless definite paracervical induration what

then is the correct interpretation? The answer is difficult and not forthcoming.

In the material at the Johns Hopkins Hospital paracervical induration was noted 107 times in 90 patients operated upon an incidence of 36.8 per cent. In 63 of these patients 58.8 per cent of 107 the broad ligament induration signified carcinomatous extension in 31.88 per cent it did not signify cancer and in 13.12 per cent the finding occurred where the histological extension was debatable.

On the other hand among 9 patients with histological extension of cancer to the paracervical tissue in whom broad ligament induration was sought for 63.684 per cent revealed induration while 29.315 per cent did not. In brief about one third of the patients with broad ligament extension of the cancer gave no demonstrable clinical evidence of it while about two thirds did. Again of the 107 patients operated upon who had clinical broad ligament induration not quite two thirds showed paracervical histological invasion of the cancer.

From these figures the rough generalization is then possibly permissible that broad ligament induration signifies paracervical carcinomatous extension in about two thirds of the patients who otherwise are considered good operable risks.

#### TECHNIQUE

The second factor of importance in the application of surgery to cancer of the cervix uteri is an adequately performed operation.

There is general agreement among gynecologists that an adequate operation for cancer of the cervix uteri involves nothing less than a panhysterectomy with removal of the proximal one third to one half of the vagina and a wide parametrial dissection which is possible only after the ureters have been demonstrated and mobilized for their distal 10 centimeters or more. Considerable difference of opinion exists as to regional gland extirpation. As a result three groups of operators exist each using one of the following procedures:

1. *Routine extirpation of iliac and obturator glands.* This is the procedure originally advocated by Ries in 1895. At the present time



Fig. 1 Normal cervical epithelium

Victor Bonney of London is the active exponent of this procedure. In the United States C. Jeff Miller and Howard C. Taylor<sup>1</sup> if they operate utilize this procedure which was also used by Bumm, Doederlein and Zweifel in Germany.

2. *Extirpation of regional lymph glands only when palpably enlarged.* This is the procedure advocated by the late Ernst Wertheim, his pupil Weibel and many others. In the United States Graves,<sup>1</sup> Spalding<sup>1</sup> and Cobb advocate a similar procedure.

3. *Non removal of regional lymph glands.* Most gynecologists who now operate for cancer in this location follow this method. Cullen is its outstanding exponent. He operates in all operable cases. Among others who do likewise may be mentioned Peterson of Michigan, Davis of Harvard and Hartmann of Kansas.

It is difficult to find a rational explanation for these three divergent points of view and practices. There is however excellent reason for two of the methods, namely the first and third.

Regarding the routine extirpation of regional pelvic lymph glands the altogether logical explanation is that this is the correct operative procedure in all cases of cancer in which the regional lymph nodes are accessible. Against this practice may be noted (1) the increased primary operative mortality (2) the

These geographical variations in



Fig. 2 Small cell cancer with an epithelial pearl

involvement of inaccessible lateral aortic glands in certain cases in which lymph node metastases exist (3) the comparative inability to effect permanent cures in patients with lymph gland metastases. The experience at the Johns Hopkins Hospital reveals that none of the patients with lymph gland metastases was permanently cured. However 7 per cent of those with lymph gland metastases (as shown by microscopic examination of extirpated glands) were free of recurrence at the end of 5 years. The experiences of Weibel (16), Wertheim (17) and Rosthorn (reported by Schottlander and Kermauner 14) are virtually the same. Weibel does not believe that removal of cancerous lymph glands produces any important increase in the 5 year cures.

On the basis of the foregoing we feel that the operation fulfilling the minimal operative requirements previously given with non removal of the regional lymph glands has a rational basis for the surgical treatment of this disease.

There is probably not much to recommend the procedure of extirpating only enlarged lymph glands for these may be merely inflammatory hyperplasias while glands which are scarcely palpable may be completely occupied by carcinomatous metastases.

TABLE I PERICERVICAL INDURATION AND ITS SIGNIFICANCE

Induration	at	t	p	d	p	(36%)	f	q	90
Induration	at	d	t	d	a	t	n	158%	7
Induration	at	n	d	t	l	t	n	(89)	6
Induration	t	d	t	l	u	t	bl	t	1
(of 0)									3

TABLE II PERICERVICAL EXTENSION OF THE CANCER AND THE INCIDENCE OF PERICERVICAL INDURATION ACCOMPANYING IT

P	t	nt	h	gh	t	l	l	t	n	f		9
I	t	t	pr	t	g	l	n	l	i	l	durat	63
(84%)												9
P	t	nt	p	nt								9
t	n	(35%)										

A recent report (196) by Victor Bonney (4) of London is decidedly at variance with the experience at Johns Hopkins and other clinic and it challenges attention. Bonney practices routine extirpation of the iliac and obturator lymph nodes. Among 130 patients who were operated upon 10 or more years ago 50 showed lymph gland metastases. Of these 11 (2 per cent of 50) are free of recurrence and on the basis of this Bonney continues lymph gland extirpation.

**Anesthesia.** With a primary mortality varying from 4 to 0 per cent in this operation every phase of the operative technique has received close scrutiny.

Surgical anesthesia is an integral part of the operative technique for cancer and it probably is not an exaggeration to say that in the last decade and a half greater advancements have been made in the refinements of anesthesia than have been made in the fundamentals of surgical technique as employed in the for most clinics. Particularly in America the cradle of ether anesthesia has advancement been made in the technique of inhalation narcosis. The correct employment of ethylene carbon dioxide oxygen mixture with minimal amounts of ether is destined. I am certain to lower materially the primary mortality in radical operations for cancer of the cervix uteri.

Ethylene anesthesia permits perfect relaxation. At the end of a difficult 1/2 hour opera-

tion not complicated by excessive hemorrhage the patient is in excellent condition—a fact which cannot be appreciated by any but those who have actually experienced the situation. Instead of the customary pale clammy moist profoundly narcotized woman with tachycardia and marked vascular hypotension one sees a warm pink patient with only slight acceleration of pulse and a blood pressure little altered from what it was prior to operation. By the time she has been returned to bed she is conscious and in an hour to two can easily engage in intelligible conversation.

In England and on the Continent where inhalation narcosis in most clinics is produced with chloroform and chloroform ether mixtures the operators have sought refuge in the injection of anesthetic solutions particularly in spinal anesthesia. This procedure in expert hands according to Doederlein produces a mortality of less than 0.1 per cent. Its employment is considered by Bonney to be a large factor in his decreased operative mortality of 1 per cent. Suessmann (15) has reduced his initial mortality to 3.5 per cent in 168 patients on whom radical operations were done and spinal anesthesia was used while Weibel (16) reports a 4.2 per cent mortality in 48 personal cases operated upon.

**Operative mortality.** Without going into tedious detail a word may be said about operative mortality as it concerns the radical operation. Table III is self explanatory and reveals the present distribution of mortality in different clinics.

When one considers that in some clinics operative shock is one of the most frequent single causes of death at operation it is apparent that the previously noted improvements in anesthesia are necessary and should reflect a definite reduction in the operative mortality due to shock.

In the Johns Hopkins Hospital up to 1919 2 per cent of the operative deaths were due to surgical shock. From 1920 to 1936 inclusive only one operative death due to shock occurred. It is safe to say that the administration of anesthesia by trained anesthesiologists has been an important factor not only in this improvement but also in lessening other post-

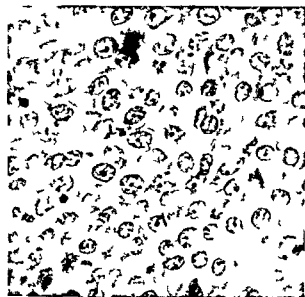


Fig 3 Transitional cell cancer



Fig 4 Spindle cell cancer

operative complications such as abdominal distention (6)

#### CRITERIA FOR PROGNOSIS

Two types of prognoses are often desired by patients and more particularly by the immediate family viz (1) the outlook as to the patient's ability to withstand the immediate operative procedure and (2) the possibility of an ultimate cure provided the patient survives operation.

The first query can be immediately answered. In correctly selected patients who are properly prepared for operation an operative mortality of not over 5 to 6 per cent should be anticipated. In comparatively early cases in which the disease is limited to the cervix a mortality not over 1 to 2 per cent should occur. This may appear at variance with some of the figures in Table III. However in numerous instances these figures represent operations performed on patients who presented local processes technically most questionably operable while the patients themselves were poor operative risks.

The second request to look into the future cannot be met until the operation is over and the pathological specimen is subjected to adequate microscopic examination. An adequate examination entails the study of numerous celloidin or paraffin microsections obtained from blocks representing all the cervical parametrium which is cut at right angles to the

longitudinal axis of the cervix the entire length and anteroposterior thickness of the vaginal cuff cervix and the corpus uteri to a point well beyond its macroscopic involvement. The adnexa should also be sectioned.

A study of this tissue should determine the extent of the local neoplastic invasion the variety of cancer (whether adenocarcinoma or epidermoid carcinoma) and if an epidermoid cancer the predominant type of cancer cell. With these data available a prognosis can be given as to the anticipation of an ultimate cure with a reasonable degree of accuracy. To lend meaning to such data it has been necessary to make a critical analysis of many pathological specimens and finally to

TABLE III SHOWING THE TREND OF PRIMARY OPERATIVE MORTALITY FOLLOWING OPERATION FOR CARCINOMA OF THE CERVIX UTERI

	P	t
Cullen of Johns Hopkins	6 to 9	0
†Spalding of Stanford	11	5
†Miller of Tulane	7	0
Lynch of California	6	6
†Graves of Harvard	4	5
Davis of Harvard	0	3
†Clark of Pennsylvania	6	0
Peterson of Michigan	6	6
Bonney	1	0
Wertheim	8	0
†Doederlein	20	7
Suessmann	3	
Zweifel	4	9
Weibel	4	2

Practice routine removal of regional lymph gland when operating

†Use radium practically exclusively

TABLE I PERICERVICAL INDURATION AND ITS SIGNIFICANCE

At t p t d upon	c
N mb h g du t (368 of 9)	90
f d t o nd t d a t n n (88 f	63
I l t o nd at l t n (89	3
I l t l t j q t bl t	3
( of )	3

TABLE II PERICERVICAL EXTENSION OF THE CANCER AND THE INCIDENCE OF PERICERVICAL INDURATION ACCOMPANYING IT

P t t h g h t l k l t f	0
P t n s p n t i g l l l du t n	63
(684)	
I t t p t g l n l p ) )	0
t n (3 )	

A recent report (1901) by Victor Bonney (4) of London is decidedly at variance with the experience at Johns Hopkins and other clinics and it challenges attention. Bonney practices routine extirpation of the iliac and obturator lymph nodes. Among 130 patients who were operated upon 10 or more years ago 50 showed lymph gland metastases. Of these 11 (22 per cent of 50) are free of recurrence and on the basis of this Bonney continues lymph gland extirpation.

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*Operative mortality.* Without going into tedious detail a word may be said about operative mortality as it concerns the radical operation. Table III is self explanatory and reveals the present distribution of mortality in different clinics.

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studying a small series of cases operated upon also finds a distinctly more favorable outcome in the spinal cell cancers. Schottlaender and Kermauner (14) studying Rosthorn's operative material conclude (p. 689) that among the epidermoid cancers the *unripe* variety corresponding to our transitional and spindle cell types show a greater degree of invasiveness. This we have also shown.

Concerning the use of radium Schmitz (13), Cordua (5) and Pomeroy and Strauss (15) obtain their best results in the differentiated or more mature type of cancers (corresponding to our spinal cell type) while Boehm and Zweifel (3) obtain their most favorable results in the immature type of cancers (corresponding to our transitional and spindle cell types). In other words the results from the use of radium in so far as cell type is concerned are conflicting although the authors agree that there is a difference in the manner in which the various types react to radium. The latter point is well developed by Alter (1) in his careful histological studies of cervical cancer treated by radiation. The question naturally arises as to whether or not certain fairly definite criteria can be established which will make it possible with such recent distinct advance in our knowledge concerning the variations in malignancy of this type of cancer to forecast with a reasonable degree of certainty the prospect for cure following operation for cancer of the cervix. Obviously any method designed to establish prognostic criteria possesses inherent limitations that with our present knowledge are insurmountable and we fully realize that any scheme for prognosis when applied to an individual case may prove untenable.

We have studied only patients suffering from unmistakable carcinoma of the cervix uteri on whom panhysterectomies were performed that fulfilled the minimal operative requirements previously noted.

This analysis (9) concerns 145 patients in the Gynecological Service of the Johns Hopkins Hospital who were operated upon during the 7 year period between 1893 and 1900 and they fulfill the following criteria (1) they were all operated on (2) they all survived the operation and left the hospital alive (3) their

present status is known except in the case of some who have been lost after being traced 5 years.

We believe that the necessity for such a selection of cases is apparent when one reflects that we are trying to ascertain what importance if any various factors possess for determining the ultimate outcome following operation in a given group of carcinomata. For the present then we are not concerned with operative mortality but with the problem of whether or not criteria can be established that will enable us within reasonable limitations to forecast what the outcome may be in a patient who has survived the hazard of an operation.

To appreciate better the possible influence of the various factors that may possibly play a part in the determination of a prognosis each group of cancers was studied separately.

#### SPINAL CELL CANCER

In the spinal cell group we have included all of the cases in which the spinal cell type of cell is predominant irrespective of its combination with cells of other morphology. The cells characterizing this variety of cancer are morphologically similar to cells seen in the superficial zone of the stratum mucosum of normal stratified cervical epithelium (Fig. 1). The cancer cells are usually polyhedral in shape with well defined cell outlines. The nuclei many of which possess nucleoli take only a moderately intense hematoxylin stain and are separated from each other by an abundant quantity of surrounding cytoplasm which is only lightly stained by eosin (Fig. 2).

In this group are included 30 patients and of 28 the present status is known. The two exceptions are one patient who was followed for 6 years after operation and the other for 10 months after which they could not be traced.

In Table V are tabulated the cases of spinal cell cancer the salient data only being recorded. In this table as well as the subsequent tables of this type the data on the extent of cervical involvement have been omitted to lessen their size.

All patients in this group not otherwise recorded are dead—death with two exceptions

TABLE IV PERCENTAGE INCIDENCE OF FIVE YEAR CURES FOR THE DIFFERENT TYPES OF EPIDERMOID CANCER OF THE CERVIX UTERI

	J h	H k	M	(1	
	II	I	mm	pe	
	I	I	I	I	I
St	1	11	—		
C	d	f B	I		
T	t	nal	II	—	
C	t	3 of I	I		
I	t	p	II	II	—
C	I	4	f B	I	
	O	I	on	C	f h
		I	II	II	I
					(M
					I
					II)
					9
					5

correlate the findings with carefully obtained and preserved case record

On the basis of such a study (7 b) it has been shown that cancer of the cervix uteri varies greatly in its malignancy. To recapitulate briefly a study of the pathological material from 387 cases of cancer of the cervix uteri at the Johns Hopkins Hospital revealed that aside from the adenocarcinomata the epidermoid cancers could be divided into three large groups each being designated according to the type of cancer cell predominating. There were necessarily various combinations of cell types encountered but it was found that the predominant variety of cancer cell indicated the relative malignancy of the individual process.

As a working classification then we have (1) pinal cell cancer (2) transitional cell cancer and (3) spindle cell cancer.

To illustrate this distinct variation in malignancy of cancer of the cervix uteri the relative frequency of so called 5 year cures (as given in our first paper occurring in each of the types of cancer as grouped above) is given in Table IV wherein are also compared the results obtained at the Mayo Clinic as reported by Broder.

The results as shown in Table IV are so closely comparable as to stimulate skeptical speculation. However it is worthy of consideration that the work in Rochester and in Baltimore was carried on independently and without knowledge on the part of either investigator that such work was in progress elsewhere.

This of itself practically refutes Plaut's (9) statement and inferences that it is impossible to have pathologists agree on a few characteristic cell types in carcinoma of the cervix uteri. As was shown in our first paper (7) numerous combinations of cell types occurred in our study so many in fact that for the sake of clearness some were not enumerated. However in practically all instances where a sufficient number of well cut and stained celloidin or paraffin sections were studied it was possible to determine the predominant type of cancer cell. Naturally in some specimens it was impossible to be certain which was the predominant cell and particularly intricate were those cases in which one could not satisfactorily decide whether certain predominant cells should be classified as spinal or transitional. Any confusion that arose was practically confined to these two groups for it is readily seen that when for example a well defined cell membrane is not visible about a cell that would otherwise conform to our description of pinal cell we would then be forced either to establish another group (which was done at first in that way segregating all these doubtful cases) or to include them in the spinal or transitional cell groups. The latter course was adopted when the material from our study was grouped and classified. To one experienced in this type of work it is at once obvious that the transitional cell classification would become the large dumping ground for doubtful cell types for it is the transitional cell group that takes in all the varied forms that do not conform to the spinal or spindle cell description.

It is also quite obvious to pathologists that the classification or description of all the numerous cell forms seen in cancer would be an endless if not an impossible and useless task. For this reason we had to confine our study to the predominating cell types in order to see what such an investigation might offer. This is shown in Table IV.

While Plaut attempts to compare his results with ours he does not stress the important fact that his cases have all been treated by radiation while ours were treated by radical operation a fundamental difference. On the other hand Pemberton (10)

the greater the involvement in thickness the more likely is pericervical dissemination to occur

In Table VI we have tabulated the extent of cervical thickness involvement in the patients who had spinal cell cancer but who are now in good health. The results appear to emphasize the apparent unimportance of the extent of cervical involvement provided no pericervical dissemination occurs.

*Type of operation performed.* Radical pan-hysterectomy through the abdominal cavity was the operation performed on 5 (8.3 per cent) of these patients. Vaginal pan-hysterectomy was performed on 4 (13.3 per cent) and a combined vaginal and abdominal operation on one (3.3 per cent).

Of the patients who had the abdominal operations performed 12 (48 per cent) are living and well. One (25 per cent) of the four who had a vaginal pan-hysterectomy performed is living while the only patient in this group who had a combined operation is now in good health.

*Duration of symptoms.* What part the duration of symptoms plays in our scheme of attempting to foretell the ultimate outcome in a given group of cases is probably difficult to estimate in the spinal cell group of cancers. We are arbitrarily selecting the eighth month of symptoms as the point beyond which a cure cannot be reasonably expected. However in only 5 patients in this group were the symptoms of more than 8 months duration and 2 of these 5 had none of the extensions that would ordinarily constrain us to consider them inoperable. It is then obvious that were there more patients in this group of cancers our data might be different. Fully appreciating the shortcomings involved we have on the basis of our data taken a symptom duration of 8 months as the time limit beyond which an operative cure for spinal cell cancer may not be anticipated.

*Diagnostic curettage.* For years it has been a routine procedure at the Johns Hopkins Hospital to obtain tissue for microscopic examination before the radical operation is performed. The custom now is to examine frozen sections before we proceed with the extirpation. It happens occasionally that in some

TABLE VI SHOWING INVOLVEMENT OF CERVIX AT DIFFERENT PERIODS OF DISEASE IN PATIENTS WHO HAD SPINAL CELL CANCERS AND ARE NOW LIVING AND WELL

Involve- ment in thick- ness	0	1	2	3	4	5	6	7	8	9	10	Wh C
4	1	1	0	0	0	0	0	0	0	0	0	1
6	0	0	0	1	0	0	0	0	0	0	0	2
8	0	0	0	1	0	0	0	0	0	0	0	1
Total	(14)	1	1	1	1	1	1	1	1	1	1	8 (55%)

TABLE VII CURED PATIENTS IN SPINAL CELL GROUP

Five year cures in patients not necessarily operable	16	53.3
Permanent cures	14	46.6
Operable patients in this group	22	
Permanent cures in operable group—14	22	63.6

early cases the freezing method is not adequate for the preparation of sections sufficiently thin to permit of a microscopic diagnosis. In such instances the patient is put back to bed and nothing further is done until rapidly prepared celloidin or paraffin sections are available for examination. The importance of obtaining tissue for examination prior to the radical operation cannot be sufficiently stressed for it has proved of value in two ways preventing on the one hand a serious operation where no cancer exists and on the other occasionally revealing cancer where none was suspected (Cullen).

Diagnostic curettage several days prior to the radical operation was performed on 10 (33 per cent) of these patients. Three of these may be classified as cured so that of the 14 cured patients we did a preliminary curettage on 3 (21.4 per cent).

*Cured patients.* Five year cures so called are therefore seen to have been effected in 16 patients (53.3 per cent of 30) in the spinal cell group and permanent cures in 46.6 per cent. However in analyzing Table II more carefully it will be noted that of the 30 patients forming this group, in 4 there was a definite pericervical extension. One not included in the four just mentioned had iliac gland metastases and three others not included were beyond the eighth month of



TABLE V—SPINAL CELL CANCER

	I	t	f	y	m	m	h	
	4	5	6	7	8			8
N mb								
E								
D								
I								
P								
M								
M								
T								
C								
V								
Abd								
D								
L								
N								
P								
I								
L								
R								

being due to the sequelae of cancer and occurring not later than a year after operation.

In studying Table V one is immediately impressed by two outstanding figures: first the regrettably small number of cases and second the occurrence of cured patients. If one were to plot a curve of the cure in relation to the duration of symptoms before operation, one might conclude that it is just as well to operate late in the disease in spinal cell cancer as to intervene during its incipency. Such a deduction would not be justifiable but nevertheless one cannot but be impressed by the high incidence of patients who are living and well in the group in which the symptoms were of a duration of 1 to 8 months.

**Metastases.** None of the patients in this group with demonstrable metastases have remained well, all dying of recurrence, although one patient with symptoms of 12 months duration and metastases to the iliac glands lived 8 years before succumbing to a recurrence.

**Extension into the pericervical tissues.** All patients with definite extension of the neoplasm into the pericervical tissue and we include one extension to the bladder and rectum have died of recurrent cancer, but if the extension was questionable as occurred in two instances the patients are still in good health. Four (13.3 per cent) of these patients showed histological evidence of cancer extending beyond the radial confines of the cervix.

**Extension to the uterus** occurred in eight instances (4.2 per cent) and in three of these

(37.5 per cent of 8) the patients are well so that in this group of cancers invasion of the corpus uteri is not incompatible with operative cure. However a more critical analysis of this particular phase is even more relevant and shows that an operative cure of 60 per cent occurred in those in whom extension to the uterus was uncomplicated by pericervical extension of the disease.

It would appear therefore that in carcinoma extension from cancer of the cervix that which is confined to the uterus is of least serious import. On the other hand escape of the uterus apparently improves the postoperative prognosis for of the 14 patients who are cured in 11 (78.8 per cent) there was no extension to the uterus.

**Vaginal involvement.** In case the vaginal involvement is not so extensive as to be beyond operative removal it appears that even a marked degree of it does not materially damage the prognosis for of the 7 patients with extensive vaginal involvement 4 (57 per cent) are living and well. Of the 16 patients with only moderate vaginal involvement in 3 other extensions made operative cure impossible. Of the remaining 13, 4 (54 per cent) are well.

**Extent of cervical involvement.** In this group of spinal cell cancers no definite relation can be shown between the extent of cervical involvement and the incidence of ultimate cures. Such findings hardly appear logical especially if the entire thickness is involved for it would seem reasonable to assume that

TABLE IX. SUMMARIZING THE PATIENTS WHO CAME TO THE JOHNS HOPKINS HOSPITAL DURING THE FIRST SIX MONTHS OF THEIR SYMPTOMS IN ORDER TO SHOW THE INCIDENCE OF THE CASES AS THEY CAME TO THIS CLINIC AND THEIR CORRESPONDING INCIDENCE OF BROAD INVASIVE INVOLVEMENT IN OBTAINED OR AUTOPSIED CASES

Patient type	Total number of cases	Pericervical involvement	Transitional	Spinal	Adenocarcinoma
Transitional	100	140	45	0	3
Fat spindle	33	18	7	54	35
Spinal	49	9	2	50	1
Adenocarcinoma	19	6	2	31	5

(M. 146)

TABLE IX. A. PATIENTS WITH TRANSITIONAL TYPE OF CANCER WITH PERICERVICAL INVOLVEMENT LIVING THREE YEARS OR MORE AFTER OPERATION BEFORE EVENTUAL DYING OF CANCER

Number of patients	Pericervical involvement	Transitional	Spinal	Adenocarcinoma
3	6	One third	Two-thirds	0
4	5	Entire	Entire	0
5	7	Entire	Two thirds	0
6	8	Two-thirds	Entire	0
1	3	Entire	Entire	0
18	12	Entire	Entire	0
24	13	Entire	Entire	0

No vaginal involvement  
 † limited vaginal involvement

vious communication we drew attention to the frequency of early pericervical involvement in this group of cancers which is here reproduced in Table IX and this is again borne out in this selected group of patients

The 6 patients with the exceptions noted in Table IX. A all died within 2 years after operation

Vaginal involvement was extensive in 4 patients of this group. Only 2 (8.3 per cent) of these however may be classed as cured. In fact of the 18 patients who are well only 6 (36.6 per cent) showed cancerous invasion of the vagina the involvement in 4 (22.2 per cent) being not extensive while in 2 (11.1 per cent) the vaginal invasion was more widespread though removable

TABLE X. SHOWING INVOLVEMENT OF THE CERVIX IN THE CURED PATIENTS WITH TRANSITIONAL CELL CANCER

Number of patients	Pericervical involvement	Transitional	Spinal	Adenocarcinoma	
1	5	0	0	0	
4	2	0	0	0	
5	0	1	0	1	
6	2	0	0	1	
10	0	0	0	1	
1	(16.6%)	3	(16.6%)	3	(16.6%)

The extent of cervical involvement in relation to the cured patients is interesting in this group of cancers. In Table X are grouped the cured patients to show the degree of cervical implication

From this table it is readily seen that of the cured patients in this group twice as many had one third or less of the cervical thickness involved in cancer as compared with those having more extensive involvement. These findings are considerably at variance with those for the spinal cell type of cancer and are sufficiently striking to suggest that radial cervical involvement may be an important factor in the determining of the operative curability of the transitional type of cancer

This is all the more vividly brought out when one considers the number of cured patients occurring in each of the groups into which the thickness of cervical involvement is subdivided. Of 21 patients in whom one third or less of the cervical thickness was involved in cancer 1 (57.1 per cent) were cured. Of 23 patients who had two thirds of the radius of cervix involved by cancer 3 (13 per cent) are well while of the 46 patients in whom the entire thickness was involved 3 (6.5 per cent) may be considered cured

These figures lose their striking importance somewhat when one considers that during the first 8 months of the disease the incidence with which one third two thirds and the entire cervical thickness respectively were involved was 95.86 and 65 per cent. However despite this the figures in the preceding paragraph remain of dominate importance

Table XI brings out plainly the situation existing in the group of patients who were seen during the first 8 months of their symp

TABLE VIII—TRANSITIONAL CELL CANCER

	I	I ym	m	mo	h	
	6	7	6	7	8	9
N mb						
E B gl						
F ll p						
U Bl dl						
P d						
M k l						
N l						
T f						
Y mb						
Ab l nu						
I l						
L N ml						
P d						
D d						
Low						
Rec						
O p						
h i						
m						

their symptom before coming to operation. These 8 patients according to our criteria were beyond the scope of a permanent operative cure.

It would be reasonable then to say that of the 50 patients in this group of cancers 8 belonged to the inoperable class. Therefore of the remaining patients who were operable 14 (63.6 per cent) are either living and well or may reasonably be considered as operative cures.

#### TRANSITIONAL CELL CANCER

The transitional cell cancer is by far the most common variety. Grossly it does not differ nor can it be distinguished from the other cancers in this situation. Microscopically, however, this tumor is distinctive, its cells resembling somewhat a well defined zone of cells seen in normal cervical epithelium which is limited above by the characteristic spinal cell layer and below by the distinctive single celled basal layer. Because of their resemblance to this intermediate group of cells we have designated this variety of cancer as the transitional cell type. These cancer cells have a very faint or undefinable cell membrane. The nuclei take a deep blue hematoxylin stain and are closely placed being separated by a deep eosin staining cytoplasm much less in quantity and more deeply staining than that in the spinal cells. Nucleoli are commonly observed (Fig. 3).

In Table VIII are tabulated the salient features regarding the patients having the transitional type of cancer.

*Metastases to the iliac glands* were demonstrated in 4 patients of this group all but one dying in less than 1 year after operation. This patient who came for treatment in the ninth month of symptomatic disease died 5 years after operation. She was the only one of the four to have a diagnostic curette several days prior to operation for radical extirpation of the process.

*Metastases to the fallopian tubes* were demonstrated twice in this group, both of the patients dying of recurrent cancer, though one who had had symptoms for 3 months lived 6 years before succumbing. 5 of the 6 years being spent in complete comfort until the recurrence began to manifest itself.

*Incident of the corpus uteri* by the cervical cancer occurred in 17 instances (18.8 per cent) in the transitional type of cancer but in contrast to our results in the spinal cell group, none of these patients may be classified as cured. Of the 17 patients 5 lived two years or more following operation, one 4 years, one 1 year and one 3 years, the duration of their symptoms at the time of operation being respectively 5, 9 and 4 months. Of these 17 patients having extension of the cancer to the uterus 3 (17.6 per cent) had no associated pericervical involvement. This absence however did not seem to indicate a more favorable outcome so far as an ultimate cure was concerned.

*Pericervical extension of the malignant process* occurred in 37 instances (41 per cent) though it was questionable in two. All of the 6 patients, however, died of cancer. In our pre-

TABLE VIII—SPINDLE CELL CANCER

N mb	f t t t
E f	n l m t t
Il	gl l
F H	p t be
Ur	
Bl	il
P	vac i t
M	l t t g l l m t
M	k d g l l m t
Typ	f e t
C mb	l
V	g al p hy t t my
Ab	l m l p hy t t my
P l	t t d l l t g l l s r t m t
L	
N mb	t
P	
R	

	3	4	5	6	7	8	9	10	11	12	13	14
	4								1			
	0											
	1											
	3											
	4											
	5											

findings. Were it not for the exception just mentioned it would appear that every patient whose symptoms had extended over a period of 8 months or more before operation was probably beyond the scope of an operative cure.

**Cures.** Of the patients in this group 18 (50 per cent) are living and well though these percentages could be raised to 24 if one were to consider cured those who died of natural causes or those that were lost after a period of 10 years. This has not been done however these patients being grouped with those in the last column to swell the number of 5 year cures which totals 30 patients (33.3 per cent) and comprises those living and well as well as those living 5 or more years before dying or not being traceable.

**Percentage cure in operable patients.** The question necessarily arises as to what the ultimate results would be in patients who may be considered in the light of our experience to come within the scope of operability. In this group of cancers it would appear from our findings that in addition to the criteria established for the spindle cell cancers one should add extension of the cancer to the corpus uteri as one other factor indicating the possible improbability of an operative cure.

Therefore if we consider inoperable in this group of cancers the 37 patients with pericervical extensions of the growth 3 patients with uterine extensions and 1 with ovarian involvement not included in the previously mentioned 37 we have 41 patients (45.5 per cent) out of the 90 who are definitely beyond the scope of a permanent operative cure. If we may also consider any patient whose

symptoms are over 10 months in duration as being beyond operative reclamation we may add 5 more to the inoperable group making a total of 44 patients (48.8 per cent) out of 90 who presumably were beyond the reach of an operative cure.

We may therefore reasonably consider 46 patients in this group to be operable. This then gives us a permanent operative cure in 18 patients or 39.1 per cent of those whom we consider as coming within the scope of a possible operative cure. If the 4 operable patients who died or were lost 7, 8 and in two instances 10 years after operation with out evidence of recurrence were reckoned as cures we would then have a 47.8 per cent operative salvage among the operable patients with this type of cancer.

#### SPINDLE CELL CANCER

In our first communication the cancer cell characterizing this group of cancer was referred to as the fat spindle type of cancer cell. This latter designation is unwieldy and it would probably be less cumbersome to refer to this cell as the spindle type of cancer cell and to designate this group as the spindle cell cancers.

This group forming the least common variety of the epidermoid cancers of the cervix is composed of cells which as their name implies are spindle shaped. Their nuclei assume a deep hematoxylin stain are closely placed and separated by only a small quantity of eosin staining cytoplasm. Nucleoli are occasionally but not commonly seen (Fig. 4).

The spindle cell group for this particular study comprises 17 patients. In Table VIII

TABLE VI—SHOWING THE RELATION OF THE EXTENT OF RADIAL INVOLVEMENT OF THE CERVIX TO THE INCIDENCE OF OPERABLE AND CURED PATIENTS WITH TRANSITIONAL CELL CANCER

D f ymp m	O h d f l t k				Tw th d f l t k				E th k l d			
	T t l N f t	Op p	C d t	P as l l	T t l N f t	Op p	C d t	P H	T t l N f t	Op p	C d t	P p bl cs
m	8	8	5	6 5								
	3			6 6								
3	3				6	6			7			
	3			6 6		3		66 6	7	5		
5												∞
6									5			∞
												5
8											Lo	
T l				8		6	3	8	7	8		37 5

toms in so far as the extent of radial cervical involvement is concerned. One is impressed at once by the high incidence of cures in the operable cases and the relatively low incidence of operable cases among those patients in whom the entire cervix was involved. It is also impossible not to be impressed with the scarcity of cures in the group in which the radial cervical involvement is limited to two thirds despite the high incidence of operability in so far as demonstrable inoperable extension is concerned.

*Type of operation performed.* In this group 7 patients were submitted to the combined vaginal and abdominal panhysterectomy. All but 3 died in less than 1 year after operation. Of the 3 exceptions one lived 4 years and the two others 2 years the duration of symptoms before operation being respectively 1 month, months and 6 months.

On 16 patients (17.7 per cent) a vaginal panhysterectomy was performed and 4 (25 per cent of 16) are living and well. Three of these patients were in the first month of their

symptoms while the remaining one was in the sixth month.

The most common operation was the abdominal panhysterectomy which was done in 67 instances (74.4 per cent). Of these patients 14 (20.8 per cent of 67) are living and well.

The occurrence of 5 year cures in the patients operated upon by either the vaginal or abdominal route is respectively 4.3 per cent of 16 and 34.3 per cent of 67 patients.

*Curettage of the cervical neoplasm.* Several days prior to radical operation was done on 30 (35.3 per cent) patients in this group. Of these 7 (23.3 per cent of 30) are living and well while 11 (36.6 per cent of 30) can be considered as belonging to the group of 5 year cures.

In other words of the 18 patients living and well 7 (38.8 per cent) had been curetted several days prior to the complete extirpation.

*Duration of symptoms.* A word should be said here concerning patient number three in the group whose symptoms are of 10 months duration. In this as well as in our previous study this case has caused difficulty from the standpoint of proper classification as to the duration of symptoms. Her history could well have been construed in such a way as to make the duration of her symptoms much shorter. This would also seem reasonable in view of the evident incipency of the neoplastic process as indicated by our histological

TABLE VII CURED PATIENTS IN THE TRANSITIONAL CELL GROUP

Total	mb	of pat	t	tl	g	p	Cas
3							60
Operabl	p	t	t				(33.3%)
Operabl	p	t	ts	p	ma	tl	30
							46
							(39.1%)
los	1	8	d	mb	t	dd	d f
f				ld	y	p	bl
							t
							h
							d
							7 8 per
							t

It will be noted that all patients in this group with iliac gland or fallopian tube involvement also had extension of the process into the pericervical tissues. This is also true of the patient with bladder involvement. We may consider the 10 patients with pericervical extensions of the cancer as being beyond the scope of an operative cure. These 10 cases include those mentioned in the previous paragraph and also those whose symptoms are over 8 months in duration. Therefore of the 17 patients who are now under consideration 7 (41 per cent) may be considered operable.

Cures in this group are of less frequent occurrence than in any of the preceding groups only 1 patient (5.9 per cent of 17) being alive and well today. Five year cures amount to 11.7 per cent and in this connection it is interesting to note the extensive involvement with metastases of the patient who lived 6 years after operation before succumbing to recurrent cancer.

In any consideration of cured patients we are necessarily concerned with the possibility of cure in those who are operable. In view of the fact that only 7 patients in this group come within the scope of operability the one cured patient gives us an operative cure of 14 per cent in the operable cases.

#### ADENOCARCINOMA

Nine patients in this study had adenocarcinoma as the type of neoplasm involving the cervix. Table XV gives the salient features encountered in this variety of cancer.

Adenocarcinoma is the rarest type of cervical cancer but unlike the rarest form of the epidermoid variety does not possess a similar degree of malignancy. All but two of the patients in this group who died of cancer lived 2 years or more after operation: one living 2, one 3, and two 4 years before succumbing to a recurrence. In brief of the 6 patients in this group who died of recurrence 4 (66 per cent) lived 2 years or more after operation.

*Ovarian involvement* occurred in one patient (11 per cent) operated upon during the fourth month of the disease and was associated with tubal uterine and pericervical extensions.

*Corpus uteri.* The neoplasm invaded the body of the uterus in two instances (22 per

TABLE XV—ADENOCARCINOMA

	D	t	f	sympt	m	m	th
N mb	4	6	9	18	4		
F t							
Bl							
U t							
Bl d l							
Mod							
M k							
Ty							
Al							
D l							
L v							

TABLE XVI—CURED PATIENTS SUFFERING WITH ADENOCARCINOMA

	N mb
Total number of patients	9
Cured	(33.3%) 3
Operable	4
Cures in operable patients	(75%) 3

cent). In both there was associated pericervical extension of the cancer with complete involvement of the cervix and the ultimate result was fatal. In this group therefore involvement of the corpus uteri was uniformly fatal and the outcome to be anticipated in view of the associated pericervical involvement.

It is here impossible to predict the influence that extension to the corpus uteri without pericervical involvement might have on the final outcome in a given instance.

*Bladder involvement* occurred once in this group in a patient whose symptoms were of 4 months duration. The involvement was by direct extension and the outcome fatal 3 years after operation with the employment of radium.

*Pericervical extension* of the neoplasm occurred in five instances (55.5 per cent). All of these patients died.

*Vaginal extension* of the cancer occurred in two thirds (6) of these patients. Where this extension was uncomplicated by radial pericervical extension of the cancer a cure was obtained in 2 out of the 3 patients (66.6 per cent of 3) so affected. It is obvious therefore that vaginal encroachment by adenocarcinoma of the cervix does not preclude an operative cure.

*The study of cervical involvement* is not particularly relevant except to show that 2 of the

are tabulated the outstanding features characterizing the disease in this group of cancers

TABLE XIV CURED PATIENTS IN THE SPINDLE CELL GROUP

Total number of patients	17
Living	( 7 )
Operable permanently cured	( 4%)

*Iliac gland metastases* were noted in two instances in both associated with extensive cervical and vaginal involvement as well as extension into the pericervical tissues. One of these patients with symptoms of 3 months duration lived 1 year after operation and the other whose symptoms were of 18 months duration lived 6 years before dying from the effects of a recurrence.

*Fallopian tube involvement* occurred in 2 patients; in each instance the uterus and pericervical tissues were also implicated. One of these patients lived 1 year after operation and was lost trace of while the other whose symptoms were of 24 months duration lived 2 years before succumbing to a recurrence.

*Involvement of the corpus uteri* occurred in 8 patients (47 per cent) of this group. One of these patients (12.5 per cent of 8) is living and well while another lived over 5 years before dying of a recurrence. It is noteworthy that with one exception all of the patients in this group with extension of the cancer to the corpus uteri also had pericervical involvement. The exception is the one and only patient in the group who is living and well. The uterine extension in her case is not associated with pericervical extension.

*Involvement of the pericervical tissues* occurred in 10 patients (58.8 per cent). All except one died of recurrent cancer. This patient died 2 years after operation as the result of a cardiopathy (clinical diagnosis) there being at that time no clinical evidence of a recurrence.

*Vaginal involvement in the carcinomatous process* occurred in 15 patients or approximately 88 per cent of this group. From this phase of the pathology little can be deduced that might serve to determine anything of prognostic significance in the spindle cell cancers.

The extent of cervical involvement in this group is also not particularly relevant in so far as ultimate cure or postoperative longevity are concerned because no definite relation can be shown between them.

The types of operation performed are readily seen at a glance and are not particularly relevant except possibly to note that of the 10 patients who had abdominal panhysterectomies performed 40 per cent lived 2 years or more after operation while out of the 5 submitted to the vaginal operation only one (20 per cent) lived as long. On only 1 patient in this group was the combined vaginal and abdominal operation performed and one of these (in the third month of symptoms) lived 2 years before dying of a recurrence.

*Curettage of the neoplastic process* several days prior to the radical operation for extirpation was performed in 5 instances and the only patient in this group now living is one on whom this procedure was carried out.

*Duration of symptoms* What influence the duration of the symptoms before operation exerts on the ultimate outcome in spindle cell cancer is difficult to determine. The number of patients in this group is so small that any deduction would appear arbitrary. It may, however, be noted that after the eighth month of symptoms every patient had pericervical extension of the neoplasm. This alone as previously demonstrated in our experience precluded all hope of an operative cure and from that standpoint renders the case inoperable. However a patient may live for several years in complete comfort before succumbing to recurrent cancer.

One might therefore presume that any patient with spindle cell cancer of the cervix with a history of over 8 months duration should be considered inoperable in so far as a permanent operative cure is concerned.

*Operable cases* The criteria for operability in the spindle cell group of cancers are probably similar to those recognized for the spindle cell group in view of the fact that uterine involvement by the carcinomatous process does not altogether exclude the probability of an operative cure provided of course that uterine extension is not associated with pericervical invasion.

cancers. It must be mentioned however that in the latter group the only cured patient had extension of the cancer to the body of the uterus.

*Extension to the vagina of the neoplasm in patients who could otherwise be operated upon warrants a more unfavorable prognosis than uterine extension in the spinal cell cancers.* Other factors being about equal it might be said that the prognosis for an ultimate operative cure for vaginal extension as compared to uterine extension is as 1 is to 1.4. This complication is most serious in the transitional cell cancer and is least serious of all in the adenocarcinomata. No generalization is warranted for the spindle cell cancers.

*Duration of symptoms before operation.* It would appear justifiable on the basis of our study to say that in the spinal and transitional cell cancers a duration of symptoms exceeding 8 months is sufficient to put the patient beyond the scope of an operative cure. In the case of the spindle cell cancers our study would indicate that this time limit is probably too liberal. For the adenocarcinomata no such stringent or arbitrary duration of symptoms can be predicated as for the cancers of the epidermoid variety.

*The degree of cervical involvement* provided there is no pericervical involvement appears to be a relatively unimportant factor in the spinal cell cancers as well as in the adenocarcinomata. In the case of the transitional cell cancers however the degree of radial cervical involvement immediately assumes an important role so that of the cured patients those having one third or less of the thickness of the cervix involved in cancer as compared with those having more extensive involvement are as 2 is to 1.

In fact patients with transitional cell cancer seen during the first 8 months of their symptoms who have only one third of the thickness of the cervix involved present an operability incidence of 95 per cent and the cures obtained in this operable group are 57.8 per cent. This is in distinct contrast to an operability incidence of 15 per cent and cure incidence of 17.6 per cent in the patients having two thirds of the cervix involved or an operability incidence of 31 per cent with a

cure incidence of 33.3 per cent if the entire cervical thickness is involved.

No generalization can be made for the spindle cell cancers.

*Diagnostic curettage* performed several days prior to the radical operation was done in 10 patients with spinal cell cancer and 15 per cent of these are well today. Of the transitional cell cancer patients who are living and well 38.8 per cent were curetted several days prior to operation. In the spindle cell cancer group 5 patients were curetted. This includes the only patient in this group who is well today. Curettage was performed twice in the group of adenocarcinomata and one of these patients is well at the present time.

Undoubtedly curettage for diagnosis several days prior to operation for radical extirpation does not render the prognosis hopeless.

*Prognosis in operable patients.* In the group of epidermoid cancers the spinal cell cancer offers the most favorable prospect for operative cure. Provided our criteria of operability are accepted a cure may be anticipated in 63.6 per cent of the operable cases of spinal cell cancer who survive the operation.

The transitional cell cancer comes next offering the possibility of a cure in 39 to 47 per cent of its sufferers while the spindle cell cancers are the least hopeful of all in that only a 14 per cent cure is revealed in our study.

The adenocarcinomata offer the most hopeful outlook in that 75 per cent of the operable cases may be considered cured. However we must again point out the small number of patients in this group and the danger of accepting without qualifications deductions formulated on such premises.

Minimal requirements of an adequate operation for carcinoma of the cervix uteri are presented. It is also apparent that in this restricted group of patients operated upon 45.8 per cent were evidently beyond the hope of cure by operation.

#### CONCLUSION

A postoperative prognosis in carcinoma of the cervix uteri can be made provided that the tissue removed at operation is studied with sufficient care and that an adequate operation is performed by a surgeon ade-





# OVARIAN IRRADIATION, ITS EFFECT ON THE HEALTH OF SUBSEQUENT CHILDREN

REVIEW OF LITERATURE EXPERIMENTAL AND CLINICAL WITH A REPORT OF THREE HUNDRED  
AND TWENTY HUMAN PREGNANCIES

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THE Gynecean Hospital Institute of Gynecologic Research of the University of Pennsylvania is studying the effects of irradiation upon the ovary. The chief point of interest in this investigation is the health of subsequent offspring. Extensive animal experiments are being undertaken to determine the effect of ovarian irradiation on the health of the descendants of the irradiated animals.

The subject is being studied for two reasons: first, year by year radium and the X-ray are being used more frequently in the treatment of non-malignant pelvic diseases of women; second, many of these treatments are given during the childbearing period in amounts insufficient to produce permanent sterility. Women so treated have subsequently borne children, but because some of these children presented developmental defects, this gave rise to the belief that they were produced by the maternal irradiation.

The present study is undertaken in the hope of learning whether the defects described are due to the maternal irradiation or to other causes. If these defects are due solely to irradiation, this should be well understood in order to prevent their future occurrence.

This article is intended as an introductory paper to further studies upon ovarian irradiation. In it the contemplated investigation is outlined, and the animal experimental and clinical evidence as set forth in the current literature is reviewed.

## OUTLINE OF CONTEMPLATED STUDY

On account of the importance and complexity of the problem, only a single aspect of ovarian irradiation is being studied. The health of offspring born following therapeutic maternal pelvic irradiation was selected as perhaps the most important clinical phase of the problem needing investigation.

This research is both a clinical and an experimental one. The clinical portion consists of an analysis of the health conditions of children born of mothers receiving therapeutic pelvic radium or X-ray irradiation either before or during the pregnancies concerned. The material for the present communication was secured from reports found in the current medical literature.

The second part of the clinical portion consists also of an analysis of the physical condition of children born of similarly irradiated mothers but as yet unreported. The data are being gathered from questionnaires sent to various observers and clinics throughout the United States.

The animal experimental portion of the work consists of observations made upon the progeny of white rats. Only one generation of females is receiving ovarian irradiation prior to mating in order to permit a study of the inheritance of any possible defects induced by such treatment to be made. This investigation is being supplemented by histological observations made upon the changes observed in the ovaries of rats thus treated.

## REVIEW OF LITERATURE EXPERIMENTAL AND CLINICAL

### EXPERIMENTAL STUDIES

The observations of thirty-seven workers have been studied in order to ascertain what experimental evidence there is at hand to indicate the part played by irradiation in the production of defective offspring in animals. For want of space the abstracts of these experimental studies have not been recorded in detail. The references to them appear in the bibliography from 1-41 inclusive.

These observations have been made upon a variety of animals and in most instances evidence has been found indicating that the



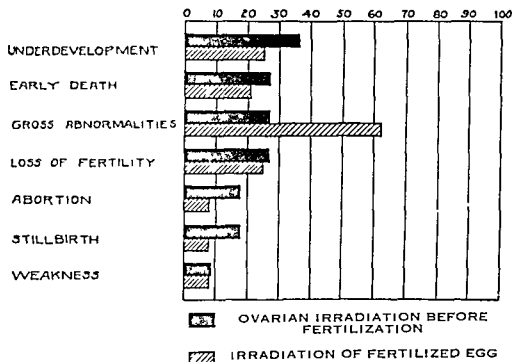


Fig. 2. Irradiation effects upon animals and their offspring. Data presented here are the same as on Figure 1, only plotted according to whether the irradiation was received before or after fertilization of the egg. Note the high frequency of gross abnormality production when the fertilized egg is irradiated. The small number of experiments (37) the wide variety of animals and insects employed the absence of negative findings in many of the reports and certain other factors such as the disproportion of preconception experiments (7) as against the larger number of postconception experiments (30) make a correct appreciation of the various findings charted here extremely difficult.

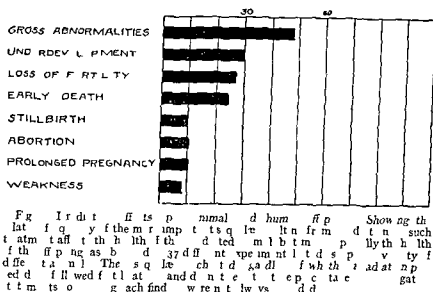
dence confirming this belief is as yet by no means abundant nor is it believed to be more than suggestive of damage. For this reason additional experimental and clinical evidence is deemed necessary before a final satisfactory answer to this problem can be given.

*Pre fertilization irradiation of animals.* Pre fertilization ovarian irradiation has been found to delay the onset of pregnancy in rabbits (Zaretsky 41) but to be followed by the production of normal young. Prolongation of pregnancy has also been observed to follow this form of irradiation (Driessen 10, Lacassagne and Coutard 21) as has likewise abortion (Trillmich 38, Bergonie and Tribandau 5). Stillbirth has been observed by Trillmich (38), Driessen (10), Lacassagne and Coutard (21). Early death of offspring has been noted by Okintschitz (30) when irradiating mice and by Sebileau (35), Driessen, Lacassagne and Coutard when irradiating rabbits. Underdevelopment has also followed preconception irradiation (Driessen, Lacassagne and Coutard) and Driessen has observed general

weakness of the offspring after the treatment. Gross abnormalities have been noted by Lacassagne and Coutard and in this country Bagg and his co-workers have apparently demonstrated the presence of gross abnormalities in mice apparently the result of maternal irradiation. Bagg in a personal communication states that he has been unable to reproduce the original defects in a second set of similar experiments.

In addition to the gross changes seen by the above writers certain of the cytologists (Mavor 26, Muller 27) have observed striking effects in the structure of individual cells especially in the nucleus following irradiation. It has been shown that irradiation may disrupt the normal chromosome arrangement in the nucleus without altering the viability and that following such treatment atypical monsters may be produced. Hinrichs who recently reviewed the literature on irradiation effects upon living tissues says that

1. The chromatin is more susceptible to irradiation than is the rest of the cell.



young of these irradiated female animals suffered injury because of the maternal treatments. The chief disturbances observed in the order of their frequency are presented graphically in Figure 1. In this diagram loss of fertility and prolongation of pregnancy refer to the irradiated mothers and not to the offspring. From this diagram it appears that gross abnormalities among the young of irradiated mothers are not infrequent and underdevelopment and early death are also important sequelæ.

The observations on Figure 1 were recorded irrespective of the time with regard to fertilization at which the irradiation took place. In Figure 2 the same data are graphically presented but in a different fashion. Here the black bars represent the sequelæ observed when irradiation preceded pregnancy or fertilization of the ovum, whereas the cross hatched bars represent the effects of irradiation administered during pregnancy or after fertilization of the ovum had taken place. In the latter case the developing embryo was directly irradiated and here there was a decided increase in the frequency of gross abnormality production. Figure 2 based on a small series of experiments upon a wide variety of animals and insects presents contrasts between pre-conception and post-conception effects which may give erroneous impressions as a result of these facts, namely the

small amount of material and the conditions under which they were carried out.

In a number of the animal experiments forming the bases of Figures 1 and 2 only a small series of animals was employed and in some of these experiments no controls were used. It is quite possible that if more thorough and complete observations had been made the final results would have been different.

For the purpose of making easier comparison Figures 1 and 2 have been drawn to a scale of one hundred. These results do not however represent true percentages since in most of the reports examined negative statements were not recorded for each of the findings charted. This fact however ought not to alter our opinion concerning the great frequency of gross abnormality production as recorded in Figure 2.

The great frequency of occurrence of gross abnormalities among the young of animal irradiated when pregnant or after fertilization of the egg as the case may be would seem to prove that the irradiation was the cause of the disturbances observed. Most of the experiments in the series studied were carried out upon the fertilized egg. The few remaining studied—some six or seven in number—upon pre-fertilization irradiation suggest that subsequent offspring may suffer as the result of pre-conception irradiation. The evi-

1 *Irradiation of the developing embryo* is extremely likely to injure its health and future development

2 Pre fertilization ovarian irradiation of animals may injure the health of subsequent offspring

3 Additional confirmatory experimental evidence would be of great value in determining what effect preconception or pre fertilization irradiation really has upon the health and development of future offspring

4 The health and development of all children born of mothers who have received pelvic irradiation during or prior to the pregnancies concerned should be studied carefully in order to ascertain whether such maternal irradiation has had any harmful results upon the health of the children

#### OBSERVATIONS ON HUMAN BEINGS

A study of the current literature has been made in order to gather as much information as possible concerning the health of all children whose mothers received pelvic radium treatment or X ray irradiation during or before pregnancy. Approximately 30 such pregnancies have been reported. Few observers have published more than one or possibly two personal observations on cases associated with irradiation given during or preceding pregnancy. Where other authors cases have been quoted original sources have whenever possible been examined and an attempt has been made to secure all available data bearing upon the health of children born of irradiated mothers following such treatment regardless of the time that had elapsed between the treatment and the conception. In a few instances there were twin births. In eleven cases second children were born following one radium treatment or X ray pelvic therapeutic irradiation and of these eleven women four conceived the third time.

The large number of pregnancies recorded in this investigation are explained by the fact that a group of forty nine pregnancies were reported by Pinard (129) with practically no details of the treatment. It is quite possible that if such details had been included many of these pregnancies might have been omitted as unsuitable for this study and the grand total

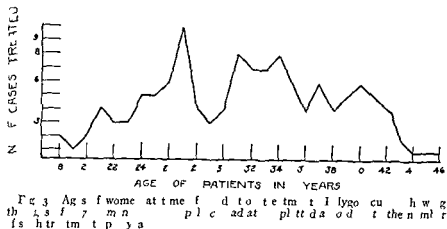
have been thereby reduced. There were 113 reports examined. The first report was made in 1906 and from that time until 1908 relatively few cases were recorded. In 1920 there was a decided increase in the number of observations and since then the number of investigations recorded each year has been fairly constant.

Lack of space prevents the publication of the abstracts of the case reports from which our material was drawn. The references (4-156) in the bibliography however give the sources from which this material was secured. To the best of our knowledge it includes all reports of pregnancies associated with irradiation in which details bearing upon the health of the children or of the fetuses concerned were found. Therapeutic abortions performed by means of X ray irradiation in which no description of the development or health of the fetus was included were omitted from this consideration. It was believed that such cases would be of no value in this study since the health or development of the child thus born was the chief point of interest. On the other hand cases in which accidental abortions occurred although no mention was made of the health of the fetus were included in order that we might learn the effect of irradiation upon the abortion rate.

The ages of the women receiving irradiation were mentioned 122 times. The youngest woman treated was 18 and the oldest was 46 years of age. Figure 3 is a polygonal curve indicating the number of treatments given arranged according to the ages of the women treated. According to Norris (121) the peak of the curve between the ages of 27 and 34 represents the period of greatest fertility.

Meager data bearing upon the health of children born prior to irradiation treatments were found but in a large number of cases mention was made of the frequency of abortion. For this reason a study of the health of children born prior to irradiation has necessarily been omitted whereas a study of the abortion rates as influenced by irradiation has been made possible.

*Abortion rate in general population.* Since registration of pregnancies and abortions is not required in most communities it is diffi-



The dividing cell is more susceptible than the resting cell

3 Embryonic rapidly differentiating tissues are more susceptible than adult tissue

4 Weak dosage may accelerate whereas strong dosage delays cell activity

5 The more intense the irradiation and the earlier it is applied the more marked are the defects

6 The effect is more pronounced in systems where development is most precocious such as the nervous system and the vascular system

*Discussion of experimental data* All the experimental data indicate that irradiation of the developing animal embryo is a procedure that is extremely prejudicial to the future health of that individual. This evidence is convincing both in its quantity and in its quality.

Such a statement cannot be made without reservation as regards the question of pre-conception or pre-fertilization irradiation in animals. Nevertheless the available evidence in favor of such damage being possible is highly suggestive.

The facts in support of this suggestion are

1 That evidence has been presented by various observers

2 That this evidence has been confirmed by experiments upon different kinds of animals

3 That other agents such as alcohol etc (see Stockard) when parents are subjected to their influence in sufficiently large amounts are known to injure the health of offspring

4 That more than one biologist has been able to observe cellular changes affecting the hereditary mechanism namely the chromosome arrangement of the nuclei following irradiation and later has been able to confirm this by the appearance of atypical offspring

Such evidence as that just cited would indicate that pre-fertilization irradiation in the case of human beings might act injuriously upon the health of children born following such maternal treatments. Arrayed against the fact that pre-conception irradiation may injure the health of children born subsequent to maternal irradiation are the following facts based upon the experimental evidence just reviewed.

1 Very few experiments have been performed and some of these have not been well controlled

2 Injury of offspring has not always followed maternal irradiation in control experiments

Furthermore it is quite possible that the human ovary and the animal ovary may not respond alike to irradiation. The human ovum may be so sensitive to irradiation that dosages large enough to bring about the desired therapeutic results will in all cases kill the more mature ova whereas the primordial follicles may be so resistant as to withstand completely any injury that may result from such sterilizing irradiation dosage.

From our review of the experimental evidence adduced we have drawn the following conclusions

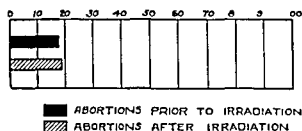


Fig 5 Abortion rate as affected by irradiation. Showing the relative abortion rates in 256 pregnancies occurring in 61 women before irradiation and the same kind of a study in these women after pelvic irradiation where 73 pregnancies occurred

uteri. Other indications included various pelvic disturbances and some diseases of a more general nature such as cardiac complaints, leukemia, psychoses and the like where future childbearing was deemed inadvisable. In these cases the pregnancy occurred in spite of the irradiation given to induce permanent sterility.

**Sources of radiant energy.** In this series of pregnancies subjected to pelvic irradiation the X ray seemed to be the method most often applied, having been definitely mentioned as being the agent employed in 108 cases, where as radium was used in 64 cases. In one or two instances a combination of both agents was employed.

**Irradiation dosage.** The exact dosages of X ray and radium as applied in this series of 320 pregnancies were not recorded. This was due to a variety of reasons. In the first place, in quite a number of instances no definite mention was made as to whether either radium or the X ray was employed, the word irradiation alone being used. However, it may be assumed that the X ray was used in most of these cases. In another large series of cases no mention was made of the dosage employed. In still other reports all details were not recorded, and when the treatment was described, the technique employed seemed to vary so much in the different cases that it was impossible to secure uniform data for analytic purposes. For these reasons no systematic attempt was made to collect information concerning the dosage. The chief criterion as to dosage in selecting these cases for study was first that a therapeutic dosage had been used in distinction to a diagnostic dosage, as in the case of X ray, that it had been applied in such



Fig 6 Abortion rates in first, second and third pregnancies following single maternal pelvic irradiation exposures. Showing the abortion frequency in eleven women following maternal irradiation. All had second pregnancies while four had third pregnancies. Note the uniformity of the rate in the first two pregnancies of these eleven women.

a manner that in all probability the ovaries received a large share of the irradiation and that pregnancy was known to exist at the time of treatment or to have followed at a later date.

**Effects of irradiation upon human offspring.** In considering the effects of irradiation upon offspring, the bearing that such treatment may have upon the abortion rate has previously been discussed, and we have seen that it apparently has little if any effect in increasing or decreasing this rate. From the practical point of view, the most important question for elucidation is whether maternal irradiation does injure the health of offspring who reach the period of viability, are born at or near term, and possess such vitality as to become personalities in the true sense of the word.

Figure 4 shows that irrespective of the time at which the irradiation is given, as regards the onset of pregnancy, approximately two thirds of the pregnancies and subsequent children are normal in every respect. Some 22 or 3 per cent of the total number of pregnancies ended in abortion, and in the final 11 per cent the offspring, when born at or near term, appeared to be defective in some respect.

In selecting the individuals to be included in this last 11 per cent, all children who were born at or close to term were considered, also those who presented even slight defects, or serious defects, or who manifested some evidence before the last observation was made that their health was not perfect, also those who died early in life. The duration of time after birth that these children were observed varied greatly. In some only the condition at birth was recorded, whereas in others observations were made as long as 7 years after birth. All children showing any disturbance



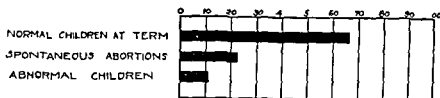


Fig 4 H lth f h m f p n f l l m a t e n l p e l a d t n S h  
 in the el t f e q n y f b o t a d b r m l h l d n a f i  
 p r g e s c a t d w i t h t h e p e t c p l m t e l d t g e n e t h  
 b f e a f t t h p a n t b e m p g n n t

cult to determine the true abortion rate for the general population. Through the kindness of Dr J B De Lee however Table 1 is presented which indicates the frequency of abortion in the cities cited.

*Abortion rate in women receiving irradiation.* From Figure 4 it will be seen that the frequency of spontaneous abortions recorded here is about 2 per cent. This applies to the 320 pregnancies observed regardless of the time of irradiation treatment as respects the onset of conception. This rate appears to be even lower than the normal rate as may be observed from Table I.

TABLE I—ABORTION RATE FOR GENERAL POPULATION IN GERMAN CITIES CITED BELOW

A b	D f	P l a	A b o p
Latzk	898	V	8 9
L t z k	9 8	V	32 7
I t z k	9 3	V n a	57
Bummi	9 7	B l n	0 4
H s h M		B l	3
Schottel u	19 9	H m b r g	5
J a c k	19		5
		A a g	33 4

TABLE II—ABORTION FREQUENCY IN MULTIPARAE AS INFLUENCED BY IRRADIATION

I a d t e d m u l t p a r a e	N m b
P e g n c e s n t h s o m p o t o i r r a d t i o	6
A b o r t i o n s t h e p g n a c	(18%) 47
P g n c s t h w o m n f i t e d t o n	73
A b t o s t h b s e q t p g n a c	(19%) 4
I t h t b l b b o g f d	
p e t f b b t h t m o o k p l b f p e c d d f	
h p t b e c m p g t	

*Abortion rate in women before and after irradiation.* Data are presented in Table II showing the frequency of abortion in irradiated women as it occurred both before and after the irradiation treatment. This material is

presented graphically in Figure 5. These per centages of 18 and 19 indicate that the irradiation has had very little effect upon the abortion rate and in spite of the fact that the patients so treated were in most instances suffering from disturbances of the generative organs which might be regarded as favorable to a high abortion rate.

*Abortion rate in first second and third pregnancies following irradiation.* Eleven women after irradiation had second children and of these four had third children. It is interesting to note that in this group all the children born at term were perfectly normal. The abortion rate for the first eleven pregnancies in this series appeared to be identical with the rate for the second eleven pregnancies there being four abortions in each group of eleven pregnancies. In the third pregnancies there were two abortions and two full term healthy children. This abortion rate is graphically presented in Figure 6.

*Abortion as influenced by the time of the irradiation with regard to the date of fertilization.* Fifty three women were irradiated at some period during pregnancy and nine aborted (16.9%) whereas 265 women were irradiated before the beginning of pregnancy with 67 abortions or a rate of approximately 6 per cent. The percentages are shown graphically in Figure 7.

*Indications for irradiation.* The indication for treatment was mentioned 177 times. In approximately 70 per cent of the women in this series of 177 cases pelvic disease was the indication for the treatment. The most important symptom was uterine hemorrhage usually the result of ovarian dysfunction. The second most important indication for irradiation was myoma uteri and the third most frequent was carcinoma of the cervix.



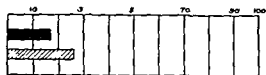


Fig 7 Abortions at a time influenced by the time of the irradiation during pregnancy

Fig 7 Abortions at a time influenced by the time of the irradiation during pregnancy. Showing the percentage of abortions at different times of pregnancy in the group of women who were irradiated during pregnancy and the group of women who were irradiated before pregnancy.

abortion were included in this group in order that the reader might appreciate the nature and the seriousness of the abnormalities recorded even though these disturbances of health might not have had even a suspicious connection with the previous maternal treatment.

In the case of the animal experiments previously recorded it was apparent that the frequency of birth of defective offspring was far greater in the group where the fertilized egg was irradiated than when the irradiation preceded fertilization or conception.

In analyzing the frequency of defective human offspring according to this same time factor the end results have been summarized in Tables III and IV and are graphically presented in Figure 8. It will be seen at once that in the human irradiation during pregnancy gives a high frequency of damaged offspring whereas pre-pregnancy irradiation gives an extremely low percentage of damaged offspring.

TABLE III—HEALTH OF CHILDREN FOLLOWING MATERNAL IRRADIATION DURING PREGNANCY

	N mb
Women exposed during pregnancy	53
Aborted	9
Full term	44
Full term children	6
Defective children	7

TABLE IV—HEALTH OF CHILDREN FOLLOWING MATERNAL PRECONCEPTION IRRADIATION

	N mbe
Women exposed before pregnancy	65
Aborted	67
Full term	98
Abnormal children	( )



Fig 8 Child health as influenced by the time of the irradiation during pregnancy

Fig 8 Child health as influenced by the time of the irradiation during pregnancy. Showing the relative frequency of different health conditions in the children born of mothers who were irradiated during pregnancy and the children born of mothers who were irradiated before pregnancy.

The question then arises as to whether in either or in both of these groups the offspring are damaged as the result of maternal irradiation or whether the defect is caused by some other agent. A more detailed study of the defects observed will help to clear up the points.

**Nature of damage in children born of mothers irradiated during pregnancy.** In the 320 pregnancies associated with pelvic irradiation treatment 53 developing embryos were irradiated while in utero. Of the children born in this group 7 were abnormal at birth. The majority presented serious developmental disturbances. The following is a list of the chief pathological findings together with the names of the authors quoted.

d C m l l 9 3 (7) pot d d th se f a  
m l l h l d d t be d r w e i g h t w h c h d e d f h  
f t e b t h F m l y h s t o r y o f l u e (X y)  
A s h n b m n g (4) e p t e d t h e a e f  
m c o e p h l c h l d (X a y)  
3 B t a d B e g i 19 (54) pot d a d e t h  
h o f l l o w g a e o p a t T h h l d v a  
p m a t d w a s n t o p o l y t h e n c r o f d u g h t  
g h t f b t h (R d m)  
4 A l b c h t (4) q t d b y F l a t u (19) p r t d  
m p h l y (X r a y)  
5 B l y ( ) q t e d b y L w s o (9) r e p r t e d  
b l d p t h l d s h e d f l o w g t c r v l d m  
t a t m t t h p t l a t d p p a e d (R d m)  
6 F l t a n 9 (7) p t d m i c r o c p h l y  
(X r a y)  
7 S t t e i 9 2 (44) e p t d a m c o e p h l y  
(X y)  
8 E Z w f l 9 2 (56) r p t d d t h f s m l l  
w l l e d l p e d c h l d (X r a y)  
9 A p t d k r m r g t 9 2 3 (44) p t e d  
m p h l y (X v)  
o B l y d B g 9 3 (47) p r t d d t h s  
d a y s T h h l d b d a p a b f i d d d u b l e l b f e e t  
(R a d m)  
B l y n d B g g 9 3 (47) p o t d d a t h f m  
p m a t m t h C a n t i w a m  
p l t d b y c l m p (R a d m)

12 Bailey and Bagg in 1923 (47) also reported a death in 11 hours. The child showed malformation of the head with *sa ittal suture open* (X ray)

13 H Little in 1923 (104) reported a microcephaly (Radium)

14 G Petenyi in 1923 (16) reported a microcephaly (X ray)

15 Schiffer in 1923 (126) reported a microcephaly (X ray)

16 Vignes and Cornil in 1923 (148) reported a case of acerebrum. A uterine sound had been passed 4 months before delivery.

17 H Abel in 1924 (42) reported a microcephaly (X ray)

18 LeLorier and Delapachier in 1924 (102) reported a slight nystagmus the second day after birth (X ray)

19 H Naujoks in 1924 (119) reported a microcephaly (X ray)

20 N Schilling in 1924 (138) reported a death in 3 hours after cesarean operation for rigid cervix (Radium)

21 A Schwaab in 1924 (137) reported a microcephaly (X ray)

22 Ganzoni and Widmer in 1925 (81) reported a microcephaly (X ray)

23 J D Lawson in 1925 (101) reported the case of a child below normal mentally and physically (X ray)

24 Moeller in 1925 (114) reported a case of hydrocephalus and monolism (Radium)

25 J Zappert in 1925 (155) reported a weak mongoloid imbecile with hypophalangia (X ray)

26 E Deutch in 1926 (64) reported a microcephaly (X ray)

27 P Werner in 1926 (151) reported a microcephaly (X ray)

Of the 53 women irradiated during pregnancy 9 (16.9 per cent) had unhealthy children at or near term or who died shortly after birth. In a few instances the disturbances of health noted might have been attributed to agents other than the previous maternal irradiation. In deCourmelles case the death might easily have been due to the familial lues. Botarro's child apparently died because of prematurity and lack of care. The bald spot on the head of the child described by Berkeley was only an insignificant defect although in all probability it was due to the intracervical radium application. The small size of the child described by Zweifel might have borne no relationship to the maternal irradiation. The child reported by Bailey and Bagg dying at  $\frac{1}{2}$  months and whose mother had suffered from eclampsia might also be eliminated from serious consideration. LeLorier's case presenting a slight nystagmus on the second day after birth could also be omitted from discussion here. Shilling's infant death following a cesarean operation for rigid cervix is also a doubtful case and may

be omitted from our list. If these children are eliminated from our consideration there still remains a large series of serious developmental defects to explain and this selected group including 14 microcephalic children would seem to indicate that the maternal irradiation must have been the exciting agent in their production. From this summary it may safely be stated that *irradiation of pregnant women when the pelvic organs are in the field of exposure is an extremely dangerous procedure affecting as it does the health of the child in utero*.

*Health of children born following pre-conception pelvic irradiation.* In this group to begin with we find a relatively small number of children born at or near term in whom there is any marked degree of impairment of health or any developmental defects. Nevertheless one cannot say definitely that this group is perfectly normal nor that the defects present are of only a mild nature. A brief list of the chief defects observed follows:

1 R Koehler in 1918 (95) reported a death in 2 days from pneumonia (X ray)

2 T Heimann in 1920 (87) reported the case of a pale but organically normal child of poor intelligence but who did not talk much. The child walked at 17 months. Author believed the trouble to be due to prematurity and the lateness in life at which this pregnancy occurred (X ray)

3 O Pankow in 1920 (125) reported the case of a child weak at birth and pale who could not sit at 9 months and who later had rickets and otitis media (X ray)

4 I J Stacy in 1920 (143) reported the case of a premature child deformed but no description of the deformity was given (Radium)

5 A Peralta Ramo in 1924 (128) reported the case of a child who was small whose skin was dry wrinkled and icteric who had two ossification defects in the left parietal bone and one in the right parietal bone. Erythrodermia appeared a few days after birth. Treatment was given only 1 month before conception took place (X ray)

6 F A Pemberton in 1924 (127) reported the death in 2 days of a 7 months fetus. Mother had eclampsia (Radium)

7 H Behrendt in 1925 (50) reported the case of a slightly underweight but normally developed child. Mother had heart trouble and severe anemia (X ray)

8 Gummert in 1925 (8) reported a microcephaly. Treatment of mother was given several years prior to birth of this child (X ray)

9 E Ries in 1926 (131) reported the stillbirth of a hypoplastic child with no right forearm, no right thumb, calvarium bones thin, caecum to left distended etc. mother an idiot (X ray)

10 D P Murphy in 1927 (117) reported the death of a well formed child following a three-day labor and cesarean section. Ca irradiated by author but delivered by another physician. (Radium)

Ab b m t t u m t d t t m f l l o w e d b y  
ir c by m t t u m t d t t m f l l o w e d b y

In studying this group of 10 children born of mothers who received their irradiation prior to the beginning of pregnancy (there being 65 women in this group) it is evident that in a number of instances the disturbances might with justice be attributed to causes other than the preconception irradiation. In this group there seemed to be no uniformity of defect as was observed in the group in which irradiation was administered during pregnancy.

Of the 10 cases listed in this preconception group 6 could be attributed to other possible causes such as the following: Case 1 prematurity and the lateness in life of the pregnancy; Case 5 child possibly syphilitic (author's view); Case 6 maternal eclampsia; Case 7 severe maternal anemia and cardiac disease; Case 9 mother believed to be almost an idiot. Defects in children born of these mothers are more frequent than in those of normal individuals. Case 10 death due entirely to difficulties of birth (author's case).

If these 6 cases can be considered as presenting disturbances or death due to factors other than the preconception maternal pelvic irradiation only 4 children in some 265 births may be regarded as having possibly received any injury as the result of the previous maternal irradiation. The 4 children presented Case 1 death on the second day after birth; Case 3 general weakness and a tendency toward disease; Case 4 a deformity the nature of which was not disclosed; Case 8 an apparently true case of microcephaly.

### GENERAL DISCUSSION

From the evidence at hand it does not seem necessary to discuss the question as to whether irradiation of the pregnant woman injures the health of the child when such treatment is administered while the fetus is *in utero*. That damage results is fully confirmed by the great bulk of experimental work upon this subject. This indicates that serious developmental disturbances are likely to result from such treatment in human beings at least when the exposures are given in what are commonly accepted as therapeutic dosages.

Concerning the effect upon the health of future children of irradiation when applied to the ovarian region *before pregnancy has taken place* no definite answer can be given. The animal experimental work indicates that damage to subsequent children is likely to result. This evidence is not yet however considered to be sufficient upon which to base a final satisfactory conclusion. A full discussion of clinical observations made upon women who have received such irradiation is necessary in order to help clarify this problem.

The number of preconception radium and X-ray treatments (65 approximately) recorded in the literature with their associated births at or close to term including only 10 cases in which the children born at that time were not normal do not present any very striking indication that the previous maternal irradiation had any definite or serious effect upon the health of the children born following such treatments.

The frequency of neonatal morbidity and mortality in the population at large is difficult to estimate and especially so in the maternity or pediatric wards of hospitals since the statistics gleaned from these institutions are influenced abnormally by the great selectivity necessarily practiced.

The wide variety of disturbances observed in the 10 children born of mothers (265) irradiated in the pelvic region prior to conception and the relatively small number of these children are both opposed to the belief that the irradiation was the cause of the disturbances. Furthermore these 265 women constituted a very highly selected group selected in most instances because of their pelvic disease. As we do not know just what relationship might exist between pelvic diseases and the health of children born of these mothers and as it is practically impossible to secure a suitable control group of women who have had pelvic disease and children without any irradiation treatment it is impossible to state definitely just what relationship there may be between irradiation treatments and the health of these children in view of the existence of the maternal pelvic disease.

Furthermore we have practically no knowledge concerning the heredity of these children.

to say nothing of the possibilities of syphilis alcoholism tuberculosis etc and the effect they may exert through the parental blood stream

There is one case in this group of children that presents gross abnormality following preconception maternal irradiation this suggests that the irradiation might possibly have had some influence in bringing about the defect and that is the microcephalic child described by Gummert This child presents the single connecting link with the group of children who received irradiation *in utero* It appears to be the only abnormality that suggests any relationship between maternal irradiation and injury to the health of subsequent offspring in cases in which the treatment preceded the onset of the pregnancy concerned According to Gummert this pregnancy took place some 2½ years after the maternal irradiation It would seem extremely unlikely that an ovum would be partially damaged live for ½ years and become fertilized As a possibility however it cannot be denied If we study the frequency of microcephaly in the population as a whole we have an additional reason for believing that this case was probably not caused by the preceding maternal irradiation According to Storrs of the Letchworth Village Colony for Feeble minded Children in New York State the frequency of microcephaly in the population at large is probably not more than one in ten thousand or more births If we go still farther it would seem that one case in 265 births would be a somewhat high rate of frequency of microcephaly and that it would be quite possible in this case for the irradiation to have been the cause of the disturbance Considered theoretically as regards the frequency of microcephaly in this group we might assume that if we had been able to study a group of some 20 000 irradiated women we might not have found another similar case

Without going into further detail concerning the frequency and nature of the disturbances observed in the children born at or close to term following maternal preconception pelvic irradiation we feel reasonably sure from the evidence at hand that the preconception irradiation was not the cause of the

disturbances cited but we cannot make this statement with absolute certainty

#### GENERAL SUMMARY

1 The literature bearing upon ovarian irradiation as it may affect the health of subsequent offspring both animal and human has been carefully reviewed

2 Frequent serious developmental disturbances have been observed in animal and human offspring when the pregnant animal or human or the fertilized egg has been directly irradiated These disturbances are severe in nature and in human beings present themselves most frequently in the form of arrested cerebral development characterized by the condition known as microcephaly

3 Abnormalities of development and structure have been observed in the young of animals that were irradiated prior to conception or fertilization

4 Children born of women who have been irradiated in the pelvic region prior to conception also present abnormalities of development and disturbances of health early death and other abnormal conditions

5 These abnormal conditions are not especially frequent nor are they uniform in character

#### CONCLUSIONS

1 Irradiation of pregnant animals or human beings is a procedure extremely dangerous to the health of the offspring concerned (61.3 per cent defective) and in the case of human beings ought not be undertaken unless such existing pregnancies are to be terminated artificially prior to the period of viability of the child

2 As yet it cannot definitely be stated that preconception maternal pelvic radium or X ray irradiation is or is not prejudicial to the health of subsequent children

#### BIBLIOGRAPHY

We have arranged the bibliography in two parts 1-41 include all references in which data were found referring to the various animal experiments summarized in first part of study 42-156 include all references in which human data were located Both groups are arranged alphabetically

#### ANIMAL EXPERIMENTATION

- 1 ANCEL P and VINTENBERGER P A The stimulative action of roentgen rays upon embryonal

- development Compt r d Soc de b l P  
924 ci 6 6-609
- 2 BAGG H J The pr sent status of our kn wi dg of  
the eff cts of irradiat n p n the gene t eo gan  
and the offspr n Am J R ntgen l 9 6 1  
529 535
- 3 BALDWIN W M Th a t f i c a l p duct o f m n  
st rs onl rm g to a d f n t type by mean f  
X r ys Ant R C 919 1 35 59
- 4 BARDEN C R f th st die th iation in  
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- 5 BE GONÉ J nd TRIBANDEAU L N t r l t A  
l f l n c d r y o l f e d t e d  
l p n Compt r nd Soc de b l 908 lu 478
- 6 BORN G f l e du rad m ur l s mau en  
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- 7 BORDIE L e l d m 9 5 4
- 8 COLWELL H A CLADSTON R J a d W k l e v  
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- F AENKEL M D R t g t ahl nd Gyna  
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- 2 Idem De v j gu d F u x gl ch n B trag  
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- 3 GILLAN P K a d BAETJER F H Som ffects f  
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- 4 v HÜPPEL d PAGE STECHER U ber d n E a f  
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- 15 HANSON F B The eff ts of X ay up th lb  
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- 16 HASTINGS S BECKTON H d We B H A  
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- 17 HERTZ G Radi mb trahlung befru htet  
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- 9 HINRICHS M A Mod fcat f d l p m t on  
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- KRONOVSKI A A Zu naly ed R nt st h  
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- 25 MARTIUS H a d FRANKEN H G baed t  
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- 26 MAYOR J W St d s o th b ol c l flect f  
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- 27 MÜLLER H J Art f c l tran mutat on f g ne  
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- 28 NÜEßBERGER L Exp m r tell U t s h e  
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- 32 REGAUD C NOGRET T nd LACASSAGNE A S r  
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- 33 SCHAPER A Exp m ntalle U t r s hu ber  
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- 34 SCHNIZ H R D R entg ab r t St hl nth  
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- 35 SEBILLEAU E Act d rayo X r l b tat  
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- 36 STOCKARD C R a d PAP NICOLAOU G N F r the  
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- 4 UNTERBERGER F Exp m t l l R t g ch ed  
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- 43 ALBRECHT H In discussion of Bayerische Gesellschaft fuer Geburtshilfe und Frauenkrankheiten Muenchen med Wchn chr 1921 lxviii 34
- 44 APFERT E and KERMORGANT L enfant des ray ns Presse méd 19 3 xxvi 1920
- 45 ASCHENHEIM E Schaedigung einer menschlichen Frucht durch Roentgenstrahlen Arch f Kinderh 1920 lxviii 131-140
- 46 AUDEBERT J Grossesse après traitement par le rayons Bull Soc d obst et de gynéc de Par 1924 xiii 159-160
- 47 BAILEY J and BAGG H J Effects of irradiation on fetal development Am J Obst & Gynec 1923 v 461-473
- 48 BASCH K Ergebnisse der Radium und Mesothoriumbehandlung der Genitalkarzinome Zentralbl f Gynaek 1918 xlii 281-90
- 49 BARBACCI P Un bambino dei raggi Riv di clin pediat 1926 xxiv 806-811
- 50 BEHRENDT H Entwicklung, Technik Anwendung und Erfolg der temporären Roentgensterilisation Zentralbl f Gynaek 1923 xlii 248-250
- 51 BEYTHIN W Strahlentherapeutische Einzelbeobachtung en Monatschr f Geburtsh u Gynaek 1921 liv 34-39
- 52 BLAND I B Radium therapy in gynecology Med J & Rec N Y 19 4 ccc 101-106
- 53 BOLAFFIO M Un eschadiged Fruchtentwicklung bei Conception in der Latenzzeit nach Kastrationsbestrahlung Strahlentherapie 19 6 xxiii 88
- 54 BOTTARO L P and BECERO DE BENCOA El radiu en las embarazadas An de Facultad de med Montevideo 1920 v 99-214
- 55 BRETSCHNEIDER Meine Erfahrungen ueber Roentgenbestrahlung der Uterusmyome auf Grund von 43 selbst bestrahlten Faellen Arch f Gynaek 1918 cxi 539-59
- 56 CASTANO C A Tres casos de embarazo después de la cunetherapia en hemorrahias ovaripáticas Semana méd Buenos Aires 1924 xxxi 1345-1389
- 57 CATHALA and MÉRAT Cancer du col de l'utérus gravide et cunetherapie Bull Soc d obst et de gynéc de Par 1923 xii 109-114
- 58 CAUFMAN H Guérison par Radiothérapie profonde d'un cas de stérilité du des troubles fonctionnels ovariens (grossesse consécutive) Paris méd 1926 lix 135-138
- 59 CHIARI R and DAUTWITZ F Reelrechte Schwan gerschaft und Geburt bei Radiumbestrahlter chronischer Leukämie Wien Arch f inn Med 1923 vi 475-484
- 60 CLARK J G and KEEVE F E Uterine hæmorrhage of benign origin treated by irradiation J Am M Ass 19 2 lxxix 546-551
- 61 CONILL V Pre-nancy after roentgen ray modification of the uterus Abstracted J Am M Ass 1919 lxxii 439
- 62 CORSCADEN J A Statistics and technique in the treatment of fibromyoma of the uterus by radiotherapy Am J Roentgenol 1922 ix 81-820
- 63 DEUTSCH F Schädigen der Roentgenstrahlen den Inhalt des graviden Uterus? Monatschr f Kinderh 1926 xxxi 84-86
- 64 DOEDERLEIN A Ueber Roentgenentherapie Monat schr f Geburtsh u Gynaek 191 xxi iii 413-420
- 65 DRIESSEN L F Keimschädigung durch Roentgenstrahlen Strahlentherapie 1923-24 xvi 6 6-689
- 66 EDELBERG H Roentgenstrahlen und Schwan gerschaft Berl klin Wchnschr 1914 li 1-62
- 67 FIMMETT J M An analysis of sixty uterine hæmorrhage cases treated with radium Internat J Surg 1925 xxxviii 181-186
- 68 FIMLER H Die Roentgenstrahlen in Gynaekologie und Geburtshilfe Hamburg 1913 140 pp
- 69 FABER A Ein Wirkung der Roentgenstrahlen auf die Sexualorgane von Tier und Mensch Fortschr a d Geb d Roentgenstrahlen 1910-11 xvi 435-459
- o FERRARI and LAFFONT Quelques cas de cunétherapie en gynécologie Bull Soc d obst et de gynéc de Par 1921 x 828-832
- 71 FIELD C E Carcinoma of the uterus with pregnancy intervening, treated successfully by radium followed by delivery of a normal child Am J Roentgenol 1922 ix 637-658
- 2 FLATAU W S Ueber Reizbestrahlung bei Hypofunktion der Eierstocke Zentralbl f Gynaek 1922 xlii 1902-1906
- 73 Idem Weitere Erfahrungen ueber Reiztherapie vermittelt Roentgenstrahlen Monatschr f Geburtsh u Gynaek 1923 lix 401-409
- 74 Idem Zwei Faelle von Schwan gerschaft nach Roentgenbestrahlung Zentralbl f Gynaek 1921 xlv 1545
- 3 FLORY L Ein Fall von Schwan gerschaft bei bestehender Amenorrhoe Zentralbl f Gynaek 19 6 1 1591-1592
- 76 FOVEAU DE COURMELLES V Rayos y productos de la concepción Semana méd 1925 xxxvii 103-106
- 7 FRAENKEL M Die Bedeutung der Zellfunktionssteigerung der Strahlenwirkung in Bezug auf Zeitsterilisation und zur Frage der Schädigung von Nachkommenschaft durch Roentgenstrahlen Strahlentherapie 1924 xvi 690-721
- 8 Idem Die Verjüngung der Frau 19 4 p 46
- 79 GAGEY J Note complémentaire sur une observation de radiothérapie pour cancer utérine avec gestation consécutive Bull Soc d obst et de gynéc de Par 19 3 xii 168
- 80 GANZONI M and WIDMER H Erfahrungen ueber den Roentgenabort Strahlentherapie 19 3 xiv 483-504
- 81 GUMMERT In discussion of Borell Zur Frage der temporären Roentgensterilisation und ihre Indikationsumraenzung Arch f Gynaek 1925 cxxv 607-608
- 82 GUTHMANN H and BOTT O Ueber die tempore Roentgenmenopausierung Ztschr f Geburtsh u Gynaek 1926 c 263-93
- 83 HANKS M E The roentgen ray as a remedy in fibroids and other gynecological diseases Illinois M J 1926 xlv 414-419
- 84 HARRIS C P Roentgen ray treatment of uterine myoma and menorrhagia Texas State M J 1927 xxii 757-759
- 85 HARTMANN and FABRE Grossesse Cancer du col Cunétherapie continuation de la grossesse enfant vivant Gynéc 1923 xvi 421
- 86 HEIMANN F Eierstockfunktion und Bestrahlung Strahlentherapie 1920 vi 731-738
- 87 Idem Myom und Schwan gerschaft Monatschr f Geburtsh u Gynaek 1921 li 292-97
- 88 HEIPMANN G geburtshilfliche Gesellschaft zu Hamburg Zentralbl f Gynaek 1919 xlii 980
- 89 HIRSCH I S Ray treatment of hypofunction of ovary with special reference to regulation of menstrual function Surg Gynec & Obst 1926 xliii 6 9-66





- 13 SCHILLING V Carcinoma of the cervix associated with pregnancy Am J Obst & Gynec 1934 vii 440-449
- 138 SCHILLER W 2ND (JR) Ausgetragene Schwangerschaft als Erfolg einer Röntgenbestrahlung Wien Klin Wchnschr 1924 xxxvii 1100-1101
- 139 SCHWEITZER B Zur Frage der Schwangerschaftsunterbrechung und Sterilisierung von Lunen und Kehlkopftuberkulose Muenchen med Wchnchr 1922 lxx 223-226
- 140 SCHUMANN H Ueber einen Fall von Schwangerschaft nach Röntgenkastration mit dem Fetus eines normal entwickelten Kindes Strahlentherapie 1919 ix 195-203
- 141 SIREDEY A and GAGEY J Le Radium en Gynecologie Paris 1922
- 142 STACY L J Radium treatment in 600 cases of menorrhagia Am J Roentgenol 1930 vii 393-382
- 143 STEITNER E Ein weiterer Fall einer Schädigung einer menschlichen Frucht durch Röntgenbestrahlung Jahrb f Kinderh 1921 xvi 43
- 144 STEIGER M Schwangerschaft und Geburt nach Röntgenbestrahlung des myomatösen Uterus Schweiz med Wchnschr 1931 1084-1087
- 145 THALER H Ueber Röntgenbehandlung der Amenorrhoe und anderer auf Unterfunktion der Ovarien beruhender Störungen Zentralbl f Gynaek 192 xlv 2034-2043
- 146 TITUS E W An analysis of two hundred gynecologic cases treated with radium at the Woman's Hospital in the state of New York Am J Obst & Gynec 1920 xi 1685-394
- 147 VIGNES H and CORNIL J Dytochie par sténose cicatricielle du col consécutive à une application intracervicale de radium Bull Soc d'obst et de gynec 1933 vii 190-197
- 148 WEIBEL W Die Behandlung der hämorrhagischen Metropathien und Myometritiden mit Radium Strahlentherapie 1920 x 911-956
- 149 WERNER P Beitrag zur Kenntnis des Verhaltens der Eierstockfunktion nach der Röntgentherapie Arch f Gynaek 1918-19 cv 434-450
- 150 Idem Weitere Beobachtungen an Röntgenkindern Arch f Gynaek 1926 cxviii 157-160
- 151 WETTERER J Handbuch der Röntgen- und Radiumtherapie Leipzig-Munich Keim und Nernst 1919
- 152 WILLCKA J Beitrag zur Röntgenreizbestrahlung der Ovarien Ztschr f Geburtsh u Gynaek 1934 lxxxvii 1-12
- 153 WILLIAMS J G X-ray treatment of gynecological lesions Long Island M J 1934 cxviii 62-65
- 154 ZAPFERT J Hat eine Strahlenbehandlung der graviden Mutter einen schädlichen Einfluss auf das Kind? Wien Klin Wchnschr 1925 xxxviii 609-63
- 155 ZWEIFEL T Erfahrungen mit Strahlentherapie des Uteruskollumkarzinoms Strahlentherapie 1923 xv 118-121

## WHAT EVERY DOCTOR SHOULD KNOW ABOUT CANCER OF THE STOMACH AND WHAT A GASTRO-INTESTINAL STUDY MEANS

By JOSEPH COLT BLOODGOOD M.D. F.A.C.S. BALTIMORE, MARYLAND

**I**N 1915 I made a complete survey of all the records of the so called stomach cases recorded in the medical and surgical departments of the Johns Hopkins Hospital and of the many other records of resected specimens which had been sent to the surgical pathological laboratory by my colleagues.

Even before the advent of the X ray there seems to have been no difficulty in diagnosing cancer of the stomach. The medical service under Doctors Osler Thayer and McRae never failed to refer to Dr Halsted's service all the organic lesions of the stomach first admitted to the medical clinic. Practically every patient with cancer of the stomach admitted to the medical clinic either died while on the surgical service or was discharged from that service. Even more important when we wrote to the patients with stomach complaints who had been on the medical service only and in whose case in each instance a diagnosis of non malignant lesion had been made we were unable to find that cancer of the stomach had later been found.

Of the cases of cancer of the stomach studied up to 1915 representing the first 26 years of the Johns Hopkins Hospital 75 per cent were inoperable and among the 25 per cent in which the cancer could be completely resected there was among the Johns Hopkins group one 5 year cure. In this case the stomach was resected by Doctor Miller who was then resident surgeon. The patient lived 9 years and died in the Johns Hopkins Hospital of cancer of the cervix. An autopsy proved that there was no recurrence of cancer in the region of the stomach and the cervical cancer was not metastatic. From all sources in 1913 there were but three 5 year cures. In the second cured case I resected the stomach at St Agnes Hospital in 1906. This patient lived until 1926 18 years and died of other causes. The late Doctor Hertwig of Buffalo New York sent me the resected

specimen of a cancer of the stomach from a patient who lived 8 years after operation and then died of malignant disease of the kidney. These three cases of cancer of the pyloric end of the stomach answered Kocher's rule which was cures could be accomplished and in his experience accomplished only in freely movable tumors of the pylorus which produced obstruction early.

When we read and carded the histories of cancer of the stomach in 1915 we could easily see from the written records that all of these patients had suffered from indigestion and had been sufficiently ill to demand an examination long before they did so—in some instances the patient being ill on an average of more than a year.

This study has shown the remarkable contrast between the education of the doctor with his great skill and precise instruments on the one hand and the lack of education of the people on the other. It was quite apparent that the failure to educate the people had rendered all the wonderful education of the medical profession and surgical skill illusory. We had anesthesia. Surgical technique had been developed far beyond the dream of Pasteur. Billroth had conceived and executed his resection of the stomach and the anastomosis known as Billroth I—duodeno-gastrostomy end to end—Billroth II—closure of the resected ends of duodenum and stomach and a gastro-enterostomy of some type. During this period 1890 to 1915 the mortality of resection for cancer of the stomach was relatively small throughout the world. The failure to cure cancer of the stomach could be explained only by the ignorance of the adult laymen their failure to realize the possible danger of indigestion.

I restudied the material again in 1916 and wrote the chapter on Cancer of the Stomach for the system of surgery which is edited by my colleague Dr Dean Lewis. Twelve years had passed. Diagnosis by the



Fig 1 Case 1 Pathol No 38634 The filling defect 10 minutes after bismuth by mouth



Fig 2 Case 1 Pathol No 38634 The filling defect 1 hour after bismuth by mouth Compare with Figure 1

X rays had improved tremendously. The mortality of resection had been reduced to a minimum. In spite of all this cancer of the stomach is admitted to the surgical clinics of the world with an inoperability of more than

50 per cent and when resection is possible with a curability of less than 35 per cent. It is quite true that every surgeon is resecting cancer of the stomach in its earlier stages and every now and then he resects a benign tumor of the type that precedes cancer but these are the exceptions not the rule. The rule is still inoperability in far too many cases for when the patients are examined with the X rays and referred to surgery the condition has passed beyond the benign stage.



Fig 3 Case 1 Pathol No 38634 Photograph of the surface of the polypoid tumor with the resected zone of normal stomach wall. For filling defect see Figures 1 and 2



Fig 4 Case 1 Pathol No 38634 Gross section through tumor shown in Figure 3. Note the normal peritoneum, muscular coats and submucosa. The tumor is like a benign wart simply a hypertrophy of the mucous membrane.



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Every member of the medical profession should know that cancer of the stomach especially on the pyloric half belong to the curable type of cancer and its complete removal is not a dangerous operative procedure but doctors of medicine must also know that the X rays both in fluoroscope and film are the only instruments of precision that will make the diagnosis possible - and diagnosis accurate - of all organic lesions of the stomach wall.

What we have to do is to teach the public to seek examination the moment they are warned of indigestion and to teach the doctor that it is really more important to study the stomach with the X ray than the heart with the stethoscope.

I have very carefully investigated the cases which I have studied personally cases which presented lesions within the abdomen with symptoms sufficient to justify a study of the stomach with the fluoroscope and film and I have been unable to find a single case in which we have overlooked a cancer of the stomach. If an ulcer or cancer in the wall of the stomach or a papilloma or any type of



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benign tumor of the wall of the stomach present it will produce a filling defect which is easily recognized in the fluoroscope and pictured in the film and this filling defect on the pyloric side of the stomach to the left of the pylorus is a positive indication for exploration.

*Inoperable cancer of the stomach.* My experience also teaches me that it is dangerous to conclude through X ray examination only that any lesion of the stomach is cancer and inoperable. The positive signs of hopeless cancer of the stomach are peritoneal exudate skin nodules in the abdominal wall or enlarged nodule of the liver.

Again and again when the X ray examination has indicated inoperability I have been able to resect the cancerous mass.

*Exploratory laparotomy.* One can explore the stomach under local anesthesia by an incision in the mid line below the ensiform and it is my opinion that this should be done in all cases except when the malignant disease is clinically hopeless. Secondary anemia



Fig. 7. Case 2. Pathol. No. 3982. Photograph of the inner surface of sleeve resected portion of the middle third of the stomach. The cancer about to perforate the center.



Fig. 8. Case 1. Pathol. No. 3982. Photograph of the fundus tumor of the inner side showing the amount of stomach wall resected. The narrow portion longitudinal of the stomach wall shows a smaller fundus of undilated stomach due to contraction from the formalin. Compare the surface of the malignant fundus in Figure 8 with the benign polypoid tumor in Figure 3.

should not be a contra indication because we may institute blood transfusion.

*What is a complete gastro intestinal study?*  
First an X ray examination of the abdomen to look for stones in the gall bladder kidney and ureter. I always combine this with an X ray examination of the chest. Then the patient can be given bismuth for an immediate fluoroscopic examination and a series of stomach films may be taken. The next day it is possible to examine the stomach a second time through the fluoroscope and films and to study the colon from the bismuth given the day before. In every instance when the findings from examination of the stomach and colon are negative and there are no indications to open the abdomen an X ray study with a dye should be made of the gall bladder. If one finds a distinct filling defect in the stomach or colon the gall bladder examination may be omitted.

If any intestinal symptom is present below the zone of the stomach or the stools show signs suggestive of disease of the colon proctoscopic examination should never be neglected and if such examination is negative an X ray should be made after the colon is filled with a bismuth enema.

The proctoscope will not fail to reveal any lesion in the rectum as far as it is possible to see with it. An X ray film made after a bismuth enema has been given will fail but on rare occasions to picture the filling defect of an organic lesion of the colon. Lesions of the duodenum and stomach are always pictured. If the filling defect or irregularity of the bulb is on the duodenal side of the pylorus we know that the defect is not cancer.



Fig. 1. C. P. th. N. 398. Ph. t. m. Graph  
(l. p.) f. t. m. h. l. q.

The first thing to do is to get correct information to the public and this is a difficult task. It is quite true that thousands of people today are coming under the observation of the medical profession for X-ray study but with few exceptions such patients have suffered for months and years with chronic disease. If their trouble is cancer it is too late. When a cancer of the stomach or colon has produced acute obstruction the patient has the best chance because he is forced to go to the hospital. But acute obstruction is rarely an early occurrence in these cases.

I have purposely omitted reference to the examination of gastric contents of feces to the use of the duodenal tube and to other laboratory examination. Of course they are part of a complete gastro intestinal study. In this short note I am anxious to impress every doctor that it is the X-ray—the fluoroscope and film—which is the instrument of precision for the accurate and early detection of organic lesions of the wall of the stomach, duodenum and colon and that the X-ray picture made after the administration of the dye is now the most accurate method of telling whether or not the gall bladder empties itself.

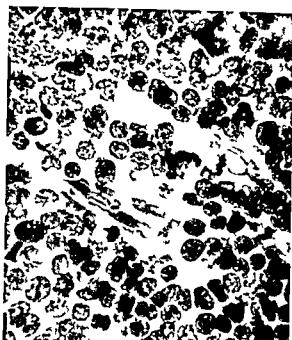


Fig. 2. C. P. th. N. 398. 2. High. p. w. ph. t.  
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An article entitled "The Survey of Stomach Carcinoma" was published in the *Journal of the American Medical Association* June 19, 1915.<sup>1</sup> The total number of cases reported was 183. The inoperability up to 1910 was 81 per cent; the inoperability in the next 5 years to 1915 had decreased from 81 to 62 per cent. Quite recently Dr. William Mayo giving the figures for his clinic for 1917 records inoperability of 50 per cent.

These figures justify the educational efforts of the American Society for the Control of Cancer and in this paper it is my desire to bring the facts before the medical profession and to emphasize the importance of an immediate X-ray study of the stomach no matter how slight the symptoms of indigestion are.

#### ILLUSTRATIVE CASES

CASE. Figures 1 to 5 picture the filling defect in the X-ray, the gross appearance of the benign polypus and the microscopic section showing a benign adenoma.

151 p



Fig 11 Case 3 Pathol No 39150 Roentgenogram showing filling defect 15 minutes after bismuth by mouth. Diagnosed inoperable by most of the examining group. At exploratory incision easily operable tumor was found. Resection Billroth I. The patient is well February 9 8 months. For gross appearance see Figures 12 and 13.

*Clinical note* The clinical history, the laboratory examinations and the X-ray study suggested a malignant tumor in the wall of the middle third of the stomach at the greater curvature. Yet at the operation a benign polypus was found and removed.

The patient claimed that his indigestion had been really bad for 3 months. I am convinced that 3 months ago the symptoms justified an examination. He can still eat a big meal only to be followed by discomfort. Palpation of the abdomen fails to disclose a mass but there is some muscle rigidity in the upper abdomen which prevents deep palpation a condition not infrequent in gastric and pancreatic lesions. The stomach contents show absence of hydrochloric acid, low acidity (9), the presence of lactic acid, pus cells, blood cells (red) and bacilli. Examination also showed moderate secondary anemia, no blood in the stools. This gastric analysis without residuum suggested cancer.

On questioning the patient again and again he admits that he has had some light indigestion for one year since 59 years of age but he explained this by the presence of recurrent root abscesses. With the intense discomfort after eating for 3 months there has been no vomiting and he has lost only 5 pounds in weight.

At the operation which was performed largely under local anesthesia with light nitrous oxide and gas ether we could see nothing wrong in the stomach which was of good size but on palpation in the middle third at the greater curvature we could feel a tumor the size of a hen's egg with a pedicle about one third of the diameter of the tumor.

The stomach was immediately opened and by sight and touch no signs of malignant infiltration

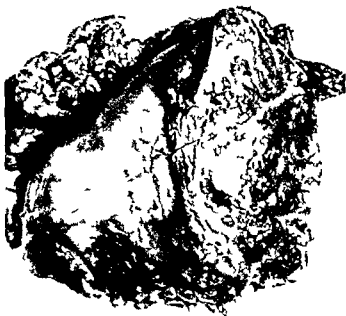


Fig 12 Case 3 Pathol No 39150 Photograph of gross resected specimen. For X-ray see Figure 11. The fungous tumor is easily seen through the gastric end at the right of the picture. There is no perforation of the peritoneal coat by tumor tissue and there were no adhesions (for longitudinal section see Figure 13).



Fig 13 Case 3 Pathol No 39150 Photograph of longitudinal section of resected stomach shown in Figure 12. Note that there is no perforation of peritoneum only slight infiltration of the muscular coat. For microscopic picture see Figure 14.





Fig. 4. C. 3. P. th. l. N. 39. 5. Low. p. w. ph. t. m. graph. h. w. g. th. lat. ly. b. g. c. ll. d. h. l. t. t. th. m. l. t. t. k. f. m. th. t. m. h. w. F. 3.

were discovered at the base. A wedge-shaped piece of the stomach wall both anterior and posterior was resected. The tumor projected from the posterior wall and the defect was sutured end to end. A frozen section similar to that in Figure 5 demonstrated that the entire tumor had been malignant but had been given sufficient margin. There was a second minute lipoid tumor which I removed without disturbing the muscular and peritoneal coat.

The patient was not shocked by the operation and had no discomforts or complications following it. On the tenth day however he suddenly developed signs of embolic pneumonia without abdominal symptoms and then a few hours later signs of embolism to the brain with rapid death. An autopsy was not allowed.

The most interesting point in Case 2 was that the tumor (Fig. 6) was just as operable as that in Case 1. Yet we knew at once in the frozen section in Case 1 that the tumor was either a benign adenoma or a possible adenocarcinoma of a low grade malignant while from the frozen section in Case 2 we knew that we were dealing with a high grade malignancy which up to the present time had not been cured by resection or any other means. When we compare Figures 5 and 10 with the microscopic sections of the three

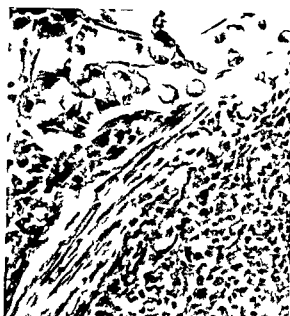


Fig. 5. C. 3. P. th. l. N. 39. C. ll. d. h. h. p. w. ph. t. m. c. ph. f. m. h. w. F. 4.

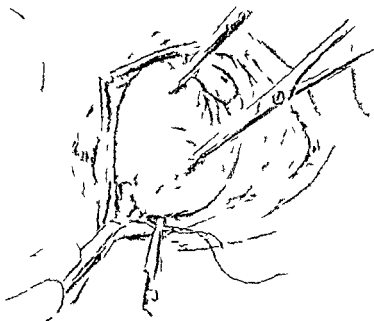
cured cases of cancer of the stomach which I reported in 1915 we will see a close resemblance with the picture in Figure 5—gross type adenocarcinoma cells of low grade of malignancy. My studies of the grading of cancer of the stomach in which the patients have lived 5 years or longer after resection are not yet complete but in not a single case do we find cells of the morphology shown in Figure 10.

CASE 2. Patient, 68 years of age. Definite gastric symptoms were observed in March but he died of me under the observation of physician. He made a complete recovery until November 8. The tumor was somewhat movable and the stomach was large. There was difficulty in resecting the middle third of the stomach and to find a stomostomy of the type of the stomach. The liver impressed me as unusually large but I could not palpate nor taste it. The patient died from the operation with an embolism. My former student and colleague Dr. Chas. H. Evansville, Indiana, reported that the patient had symptoms until about 6 weeks before death. He had sudden pain in the left side followed by death. At the post-mortem examination the following changes were noted: The stomach was normal in size and shape but the blood vessels were thickened and the

Case 3 is selected for report here because the X ray film (Fig. 11) suggested to a number of experienced roentgenologists and surgeons that the condition was inoperable. Yet the tumor (Fig. 1) was easily removed with a good margin of healthy stomach and after its resection a suture of the type of Billroth I gastroduodenostomy could be performed. Another remarkable feature is that this patient whose clinical symptoms and physical examination, palpation of the mass and X ray studies all indicated inoperability is ap-

parently well today (February, 1935) 10 months after operation without a symptom of trouble while Case 1 a benign tumor had the misfortune to succumb to a rare and unpreventable postoperative complication. In Case 2 the small and operable cancer happened to be of a high grade of malignancy and the patient died quickly of metastasis.

The action of the tumor in Case 3, which is shown in Figure 14 is of a lower grade of malignancy than that of Case 2 which is shown in Figure 10.



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# CLINICAL SURGERY

FROM THE UNIVERSITY OF KANSAS SURGICAL DEPARTMENT

## TECHNIQUE FOR THYROIDECTOMY

By ARTHUR F. HERTZBERG, M.D., F.A.C.S., HALSTEAD, KANSAS

In approaching the operation for the resection of a goiter the surgeon must have two prominent factors in mind. First the patient must be in proper condition for operation. If there has been a loss of weight the patient must be gaining must be taking food with a relish and must present the proper mental attitude toward the operation. Second enough of the gland must be removed to assure the patient of permanent relief from symptoms.

### PRE OPERATIVE PREPARATION

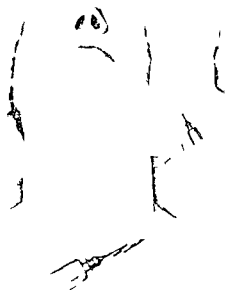
Toxic goiter patients are managed in the same way as other candidates for operation. When they enter the hospital they are told that a period of rest will be required before they are ready for the operation but that they will be informed long enough beforehand so that their friends will have time enough to be present for the operation. The non-toxic patients are told that they will require no preparation and that the operation can be performed the following or any subsequent day. The toxic patients are told as nearly as possible what must be achieved before they are ready. If they have lost weight and have no appetite they are told that they must rest until they have developed an appetite and have regained some of the lost weight. If they have lost weight and have regained some or all of the amount lost and are taking sufficient nourishment but have a rapid pulse they are told that as soon as the pulse slows to 100 or less they will be ready. In a word they are informed with perfect frankness in all regards. Everything that savors of the mysterious is carefully avoided. In my experience this is much more effective than trying to steal the gland. Most patients have friends who have undergone the operation and if their glands have been stolen the new patient will know of it and will be constantly apprehensive as to the time of operation and each day will be one of anticipation. The surgeon must employ those qualities natural to

himself to gain the patient's good will. If he has a sense of humor he may lead his patient at times with advantage. It is fatal for him to essay a dramatic attitude when he is lacking in dramatic instinct. No one surgeon has a sense of humor and a dramatic instinct; they are the antithesis of each other. After all it is the confidence the patient has in the surgeon that is the big factor. The next most important factor is the confidence born of experience that the surgeon has in himself.

*Preliminary hypnosis.* We are now using  $\frac{1}{6}$  grain of morphine given 2 hours before the operation and a like amount half an hour before the patient goes to the operating room. For slight and young patients this amount must be reduced. Pantopon in twice this amount is sometimes used. This drug is supposed to be less prone to be followed by nausea and vomiting than morphine but the advantage in this regard is very slight if there is any at all. Atropine is not used because it causes flushing of the face and dryness of the mouth; the first worries the operator and the second worries the patient. The use of scopolamine was discontinued long ago because some of the patients slept an alarmingly long time after the operation.

### ANÆSTHESIA

*Anæsthetic.* Since all goiters except those of children are operated upon under local anæsthesia at the Halstead Clinic this method alone will be considered. Novocain epinephrin is always used. Since but a small amount of the drug is needed there is no question of safety. The solution is made at the table. Three 2 grain tablets are taken directly from the commercial container, placed in a 2 ounce medicine glass and rubbed up with the plunger of the syringe. An ounce and a half of boiled water is added and the solution of the powdered tablets is assured by agitating the water with the syringe. From 5 to 8 minims of epinephrin (1:1000) is removed from the bottle by means



For the purpose of this study, the following methods were used: 1. The use of a medicine dropper which has been sterilized with the instruments. Neither novocain nor epinephrin is boiled. Such solutions have repeatedly been tested bacteriologically and found to be sterile. Novocain may be sterilized apparently without injury but epinephrin offers better results by heating. A solution which shows the following characteristics should be rejected. This method has been in use for 15 years and is no undue exertion from the effect of adrenalin has been observed. The advantage of this procedure is that the solution is sure to be fresh and as it is prepared by one of the surgical assistants the operator uses the solution with the full confidence that it has been properly made. No difference is made in the use of epinephrin in the various types of goiter. In highly toxic goiters there may be a perceptible agitation while the solution is being injected but this passes off in a few minutes but even a light reaction is unusual. Anesthesia with novocain alone is not complete and does not last more than 15 minutes—not long enough even in the hand of an expert operator. The addition of the adrenalin increases the duration of the anesthesia by four hours.

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The indications for the removal of the thyroid gland are many. A few of the more impressive ones may be mentioned. The operative field is made relatively bloodless. The important blood vessels are readily recognized and may be clamped before they are cut. The line of cleavage is clearly defined and the capsule can be followed by sharp dissection. If compression of the trachea is threatened the gland can be so manipulated as to relieve it. If the recurrent nerve is irritated a paralytic reflex at once warns the operator. The ill effects of general anesthetic are avoided. Very important is the fact that the surgeon sees his patient in the table before anything has been done. If the patient is a stated patient can be deferred to another day. No patient that is fearful of the outcome of the operation should be operated on. Slightly stated patients may be calmed by gentle assurance or by engaging them in irrelevant conversation. If the method is fail the operation must be deferred. If it happens in rare instances the patient does not bear the operation well only one lobe may be removed.

The most fatal thing to the success of local anesthesia is to promise the patient that if necessary a general anesthetic will be given. If this subject is broached the patient must be categorically assured that local anesthesia never fails. A surgeon who starts a local anesthetic with a general anesthetic in reserve is defeated before he starts.

**Anesthesia.** The patient lies on a flat table with a small pillow under the neck and shoulders and the occiput resting on the table. The pillow must not be high enough to cause the least embarrassment to respiration. In fat short-necked patients the operator may be inconvenienced but the patient's comfort must be the first consideration. It is absolutely essential to make the patient comfortable. Skilled assistants will keep the ligatures from falling on unprepared areas. If the patient shows any disposition to cough a nurse is in readiness to hold a towel over the face. However the patient's face is not kept covered as any covering would be uncomfortable and would hide from the operator the chief index as to the state of the patient. The operator should secure as comfortable a position as possible, preferably sitting on a high stool. The surgeons in our clinic do not wear masks but they do keep their mouths shut. With practice this can be done without pain. If any one feels the urge to make a speech he is advised to reserve it for the staff meeting. Studies of culture media in the laboratory have convinced me that quiet breathing through the nose does not infect the environment but talking invariably does. Elaborate head dresses are uncomfortable to the operator and the strange appearance of the surgeon tends to agitate the patient.

Perfect instruments are essential. A simple easily working syringe with a capacity of 5 cubic centimeters is used. The bore of the syringe should not be too large because the greater the diameter of the barrel the greater the pressure that must be applied to the piston and as the pressure increases the delicacy of the touch decreases. These items are of great importance for on the delicacy of touch depends the ability to determine the tissue into which the needle has penetrated. All accessory apparatus such as pressure cylinders, self-filling syringes, special needles and the like are to be eschewed because they are fatal to delicacy of touch and lead to the use of needlessly large amounts of solution. The needles should be as small as possible and the points must be sharp and free from rust. For skin infiltration a 26 gauge needle an inch long is to be preferred and for the deeper infiltration an 18 gauge needle 3 inches long should be selected. Any one doubting the



Fig. 3. The lines indicate the direction in which the needle is passed to infiltrate the ribbon muscles. Lines 1 and 2 pass over the surface of the gland. Lines 3 and 4 pass over the lower pole. The line 5 shows the direction of the needle to reach the surface of the lower pole.

importance of fine needles and smoothly working syringes can convince himself of this fact by trying to infiltrate his own leg or better still have some unsympathetic associate do it. In my judgment it is the huge syringes armed with needles the size of trocars, so generally employed that bars the general use of local anesthesia in thyroidectomies.

**The infiltration of the anesthetic.** As an introduction the gland may be gently palpated to accustom the patient to the pressure of the operator's fingers. The initial prick of the needle is likely to try the patient's nerves more than any other step of the operation. Therefore it is well to tell the patient that there will be a slight prick at the beginning. This first pain can be materially lessened by picking up a fold of the skin at the point where the initial puncture is to be made and by compressing it half a minute between the thumb and index finger cause an acute anemia. The preliminary prick can be made with very little pain at the point of maximum compression. The initial wheal should be made slowly lest the sudden expansion of the tissue cause pain. A row of wheals

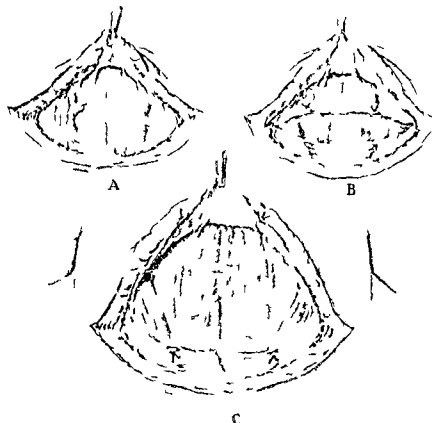


Fig. 4. I. rt. A. h. th. m. d. th. gh. th. k. f. t. l. y. a. l. plat. m.  
 m. l. t. p. g. t. f. d. th. B. h. w. th. f. a. d. d. a. d.  
 th. l. t. l. g. t. l. C. h. th. f. d. t. d. fr. f. m. th. t. b. mu. l. A. t. h.  
 h. w. n. t. l. l. v. f. l. f. p.

is made along the line of the proposed incision (Fig. 1) this being usually along one of the natural fold of the skin or on a line where a string of beads would naturally fall (Bartlett). The injection must be made endermically which is indicated by the prompt blanching of the skin. If the solution is injected below the skin anaesthesia is not instantaneous and a needlessly large amount of fluid will be used. The entire extent of the proposed incision is infiltrated as the first step of the operation.

After the skin line has been infiltrated the anterior cervical nerves are blocked at the point where they curve over the sternomastoid muscle. The needle is introduced in the anesthetized line and passed along the medial border of that muscle and just above it (Fig. 1A). The needle is then passed more deeply to reach the ribbon muscles of the neck just beneath the sternomastoid. About 5 cubic centimeters are used in this step.

Without removing the needle the surgeon then infiltrates the region in front of the trachea in order to anesthetize the region of the pyramidal lobe. This done the needle is placed between the superior pole and the trachea. Pressure on the skin over the needle (Fig. 2) will make the needle dip into this space. This blocks the superior laryngeal nerves (Fig. A) and likewise edematizes the tissue between the superior pole and the trachea thus facilitating the delivery of the superior pole.

The left side is infiltrated in like manner.

The ribbon muscles over the goiter are now infiltrated. Entered in the line of the primary skin infiltration the needle is passed into the muscles lying superficial to the gland. Care must be taken lest the needle pass too deeply injure the superficial thyroid veins and possibly cause infiltration of the tissue making it more difficult to follow the line of cleavage. The extent of infiltration depends

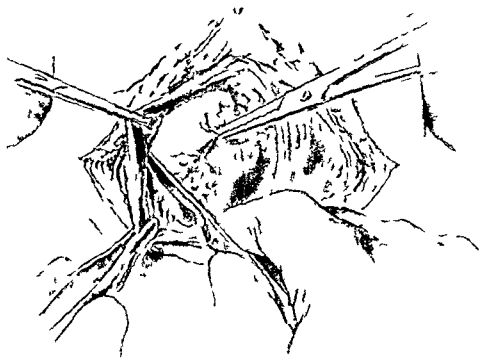


Fig 5 The ribbon muscles are being pulled laterally by an artery forceps in the hand of an assistant and a thumb forceps in the surgeon's hand. The gland is being gently lifted by an artery forceps. The knife dissects the capsule from the surface of the goiter.

on the size of the goiter. Usually four lines are infiltrated representing lines 3, 4, 6 and 8 in Figure 3. For this step 3 to 5 cubic centimeters are used.

Without removing the needle from the skin the surgeon next infiltrates the region about the lower pole. The needle is passed downward and outward as represented by line 7 and 9 in Figure 3. The purpose of this step is more to edematize the tissue about the lower pole than to secure anesthesia. By this means the line of cleavage is more readily followed. About 5 cubic centimeters are used in this step.

It will be seen that the amount of anæsthetic fluid used is only about 30 cubic centimeters. It is only in large goiters that this amount need be exceeded. The purpose of limiting the amount of fluid is not because of any fear of toxicity but because larger amounts disturb the topography and make exact dissection difficult thus making impossible the anatomical exactness in every step of the operation which is absolutely essential.

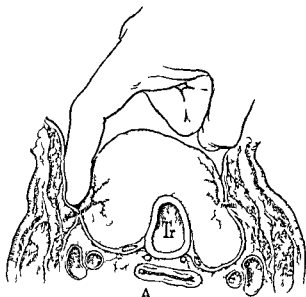
#### STEPS OF OPERATION

*The incision.* As soon as the anæsthetic has been injected the skin platysma and superficial fat are incised exposing the anterior jugular veins (Fig 4A). These veins are then caught up and the fascia is incised from one angle of the wound to

the other. The severed veins are then ligated (Fig 4B). It is essential that vessels be ligated as soon as cut. The accumulation of many forceps about the wound is unsurgical poor mechanics and above all the pull and clatter of many instruments irritate the patient. Six forceps are enough and more than a dozen is an anachronism in any operation. The fascial flaps are then dissected free from the ribbon muscles (Fig 4C). A nick is made in the lower flap in order to give greater room for the mobilization of the lower pole. The ribbon muscles are not cut because this is not necessary and the myositis resulting from such injury limits the movements of the larynx after healing takes place. The fascia is cut so as to give greater room, making it possible to remove the gland by sharp dissection and in order to give a good view of the lateral veins without the use of retractors. There is no objection to cutting the fascia because healing is perfect without disabling after effects.

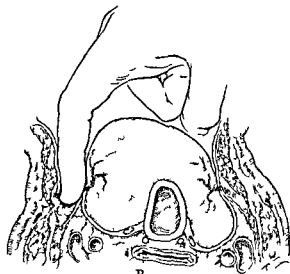
*Dissecting the gland free.* An incision is now made in the midline down to the gland capsule. If the ribbon muscles have been infiltrated to the proper degree a fine layer of edema will mark this plane. The edges of the muscles are now lifted up with the aid of artery forceps in the hands of an assistant and a thumb forceps in the operator's hands elevates the muscle at the point where the strokes of the knife are being applied (Fig 5).





A

I h o I A th m d l l l t u th t f  
t l f b l l f t l d l f g g  
t t l t l l t l th t l p h t l p o t



B

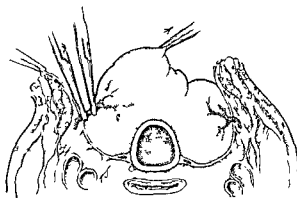
f f th l l B h l w b l t d t f l  
t t l t l f f th f m f th m d l l m t

The gland is free entirely by sharp dissection. If an attempt is made to use blunt dissection the exact line of cleavage will never be followed. Here as in any other delicate dissection the sharpest knife oftainable is the safest instrument. An artery forceps grasp the gland and makes gentle traction so that the gland may be elevated as it is freed (Fig 5). The purpose of the forceps let it be emphasized is not to extract the gland but to elevate it gently after the knife has freed it. If traction is made on the forceps they will most certainly tear out in all toxic glands. In friable glands a deeper hold is required than those indicated in the figure.

When the gland has been about half freed the lateral veins come into sight (Fig 6A). The operator must see these vessels before his knife reaches them. They must be grasped by two forceps (Fig 6) and a cut made between them. This is one of the important steps of the operation. If the vein are inadvertently cut or torn a troublesome hemorrhage ensues the exact line of cleavage is forever lost and exact operating from then on is made impossible. The reason for this is that at the point where the lateral vein enters the gland the fascia divides (Fig 6A) one leaf going out to cover the carotid sheath while the other passes around the posterior surface of the gland (Fig 6B). Unless the last named layer is identified the capsule cannot be followed behind the gland and a proper delivery is impossible. Unless the gland is properly delivered the operator cannot know how much gland he is leaving nor can he determine the existence of pedicled lobe extending beneath the sternum or between the trachea and oesophagus. Likewise unless the tracheal rings are palpable throughout the extent of the gland the operator cannot know how much of the gland he is leaving behind. This is the most important step of the operation from the standpoint of certain and lasting results.

After the gland has been fully delivered the steps looking to its removal may be proceeded with.

*Ligature of the superior pole.* The upper pole is grasped with a pair of forceps and is gently lifted



I h o I A th m d l l l t u th t f  
t l f b l l f t l d l f g g  
t t l t l l t l th t l p h t l p o t

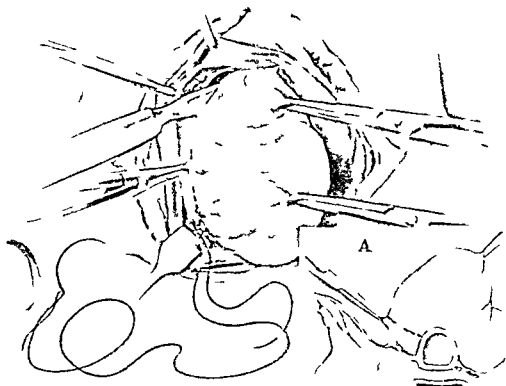


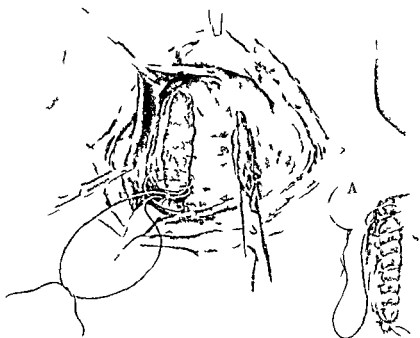
FIG. 10 Both poles have been ligated. The gland is held elevated by means of forceps while it is being severed. The incision of the guide forceps and indicates the direction of the cut and the amount of gland which is to be allowed to remain.

The index finger of the left hand (Fig. 8) supports the lateral side of the pole while with the handle of the knife the pole is separated from the trachea. If the third step in the infiltration has been properly done this area will be without sensation and the slight edema will make separation easy. When the superior pole extends very high up gradual manipulation of finger and knife handle aided by gentle traction on the forceps will bring the top of the pole into view no matter how high up it extends (Fig. 8). A Kelly forceps now replaces the knife handle and is gently pushed under the pole and raised up. One must be sure not to use the trachea as a fulcrum or the patient will be made to cough. The pole is lifted up by the raising of the forceps (Fig. 8). With the forceps we then grasp the ligature and draw it under the pole. The ligature is then firmly tied thus securing the chief blood supply early in the operation. A reversed needle holder or a special ligature carrier may be used for this step. The forceps have the advantage that they enable the operator to elevate the pole at the time the forceps pass under it. This assures a complete exposure of this part of the gland. The ligature must pass around the whole pole and not through it.

*Ligation of the lower pole* The lower pole is gently lifted so that the inferior thyroid veins come

into view (Fig. 9 frontispecie). A ligature is passed under them and tied. At this stage the lateral branch of the inferior thyroid artery may be palpated and a loop passed around it and tied. The ligature is not cut but is preserved as a starting point for the continuous suture after the lobe has been removed. This point is important especially in very friable glands for it makes possible a firm hold.

*Excision of the lobe* After both poles have been ligated the actual excision commences. The index finger palpates the posterior surface of the gland and the point of excision is fixed by means of a pair of forceps which serves as a guide (Fig. 10). The excision then begins at the upper pole and extends downward. One definite spurting vessel is always encountered—the medial branch of the inferior thyroid artery which lies close beside the trachea at the level of the upper border of the isthmus. With care it may often be seen and grasped before it is cut. Other smaller vessels inconstant in situation and number will be encountered and are grasped with forceps as they are severed. The direction of the cut and the proportion of gland left is shown in Figure 10-A. The trachea is always dissected clean. If this is not done the portion remaining over the trachea is apt to enlarge subsequently which disturbs the patient.



I b s d t h g t l t g l d t p k j t h l r l b n h f t h f t h y d t y It  
th pa d th gl th p d l bel th lg t l p d th n dl d t i d  
fl a d bl lg t t th l p l t h th ru n  
d t t d g f m th f w r to th pp pol t ll ng y bl d ng  
p t wh ch m v b t mp ly t ll d w th f p Wh th pp p l  
a l d a t p d bo tl lg t r l dy ppl d t th ppe pol (Fg 8)  
d loop l th n dl th f m g d lg tu f th pp p l  
d l f t i m d th t dg f th gl d t l th l pol  
a h d f th t d t t t l f th r g n ll w pol t

subjectively and objectively. It is impossible to remove enough of the gland if a part is left to cover the trachea. There is no objection to exposing the trachea. If the capsule has been properly elevated from the gland at the beginning of the operation and the muscle fascia layer properly coapted after the operation there is no impairment of function of the trachea. It may be admitted that the tracheal irritation is greater the first day or two following operation when the trachea is exposed. But what is a day in comparison to a lifetime? The patient wants and the surgeon must have permanent results.

**Securing the bleeding vessels.** The suture which was used to ligate the inferior thyroid veins is taken up and the needle is passed through the cut glands above the point of ligation (Fig. 11) in one or two places depending on the number of bleeding points encountered. It is then passed through the pedicle below the point of ligation and the suture is locked by throwing a loop over the needle as it is being passed through (Fig. 11) thus securing a double ligation of the pedicle. It is passed through

the cut surface again above the pedicle. In the making of this sweep the lateral branch of the inferior thyroid artery is included. The suture is now tied to the tail of the original suture passed about the inferior thyroid veins. This secures the bleeding about the lower pole. The cut surface of the gland is then whipped over from below upward care being used to include the bleeding points which have been caught up by forceps. When the pedicle of the upper pole is reached the suture is passed through the pole above the site of the ligature already in place (Fig. 11A). This is looped over the needle thus securing a double ligation of the upper pole. The cut surface is then again whipped over and the suture locked now and then about any bleeding points that may remain. This step is continued until the stump of the lower pole is reached. Then the suture is tied to the tail of the original lower pole ligature.

In very friable or large goiters particularly those that are substernal the adjacent capsule or muscle fibers may be caught up as the suture is made. This obliterates the dead spaces and gives

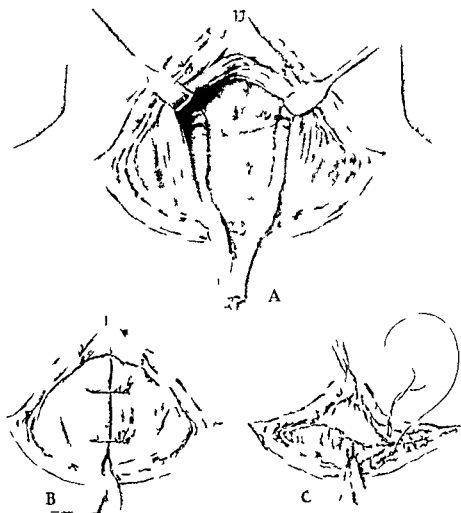


FIG. 1. A The ribbed muscles are shown retracted while gauze drains are being placed over the raw surfaces of the gland. B The ribbed muscles are gently coapted with sutures. The gauze drains protrude through the lower angle. C The fascia is being united by a running suture including, in this case, the platysma muscle.

additional security to the hemostasis in friable goiters and in old goiters gives a lateral traction to the flabby walled trachea. This however is used only in exceptional cases.

*Management of the second lobe.* The second lobe is treated in the same way except that in the very exceptional cases one must be satisfied with the removal of one lobe. I no longer remove a part of the second lobe now I remove all or nothing. If it is seen to be inexpedient to remove the second lobe cleanly at the primary operation it is deferred to a second operation a week to several months hence depending on the condition and disposition of the patient. By waiting a month or two we may much more easily remove the second lobe but in some cases time does not lessen the friability of the gland or its adhesion to the capsule.

*Drainage.* During the years when I closed the wound myself I drained only the very toxic cases. My assistants drain more frequently

perhaps about half of the cases. The drain was used because the fragility of the tissue made me fearful of late oozing. I have never drained with the idea of conducting off any toxic secretion which has been alleged to escape from the cut surface of the gland. There is no evidence that such occurs. Since we know how to prepare our patients properly before operation such hypothermia is unnecessary. When a drain is used it must be of gauze. A rubber drain should never be placed in any wound that is expected to heal by first intention. The rubber in the wound causes an exudation toward it. This prevents coagulation about the ends of the ligated vessels and invites late bleeding. Along the tract occupied by the rubber drain the exudate tends to produce a lasting fistula. On the other hand gauze hastens coagulation and thus initiates the formation of fibrous tissue which permanently seals the vessels.

The most suitable drain is a wick of gauze laid over the sutured surface of the gland (Fig. 12A).

*Closure of the wound* The edges of the ribbon muscles are coapted by sutures usually two to four in number. The muscle must not be constricted lest a myositis be produced which would limit the movements of the trachea. After the muscles have been coapted the transverse incision in the fascia is closed by a running suture (Fig. 1 B). The drain occupies the nick made in the lower facial flap (Fig. 4). The skin is closed by staple sutures of dermal gut. The platysma may be grasped with the fascia sutured separately or neglected entirely.

#### NOTES FOR THE BEGINNER

It is advantageous to estimate the difficulty of the operation before the patient is brought to the table. Even if the patient is fit for the operation very hard fixed glands should warn the novice to be cautious because the gland is friable and removal will be difficult. It is in such cases that careful infiltration about the gland is particularly helpful. Exactness of technique and not the amount of solution is of prime importance.

If the operator has started and has his morale upset at any step of the operation by excessive bleeding it is best to pack the wound with gauze and terminate the operation. The best means of avoiding such an embarrassing state is to select only those cases which are in harmony with the operator's experience and to proceed with great caution bleeding points being ligated as they are encountered in order to avoid a forest of instruments which impede the movements of the operator. The preservation of the morale of the operator is best assured by a careful technique in which nothing is done unless the operator is sure he is right. Most mistakes are made by an attempt at blunt dissection with an elevator or finger. *Blunt dissection in surgery is the mark and means of a poor operator* and this is doubly true in regard to operations for goiter. In rare instances however there may be an exception. After the surface of an excessively friable gland has been exposed and the lateral veins have been severed it may be impossible to secure a firm grasp. With the posterior capsule identified it is best to follow the lower pole to the posterior surface of the gland with the finger and thus to elevate the gland. Once the gland has been elevated

gauze can be packed behind it so as to maintain the elevation and control the hemorrhage while the poles are being ligated. If such a procedure has been necessary on the first side the second side should be deferred for another time.

#### REMARKS

*Failure to secure satisfactory results* There are two common reasons why patients are not cured: an insufficient removal of gland tissue or a wrong diagnosis.

To obviate the first as much gland should be removed as is technically feasible. The inserts in Figures 10 and 11 represent the procedure which I employ in the average case. The severer the disease the more gland should be removed. This is particularly true in patients with goiter hearts in old colloid goiters. Here small nubs about the upper poles are about all that is left. Even in such radical operations permanent myxedema is very rare. Temporary thyroid deficiency is more common and requires foreign gland treatment for a time. These have been my most striking cures particularly in the old cardiac patients. Myxedema is not to be dreaded. Patients on their grain a day live in perfect comfort.

Incorrect diagnosis accounts for many disappointments. Patients with rheumatic hearts acquired in childhood may later acquire goiter. These hearts are not cured by goiter operations. History and physical examination should preclude this error. Less easily the diagnosis of extraneous nervous symptoms in goiter patients. The presence of a goiter does not lessen the importance of a careful consideration of the general nervous state. Early history and a study of other members of the family will aid. The nervous symptoms in thyroid intoxication differ from the vagaries of the neurotic. When both conditions are combined the surgeon can but accept the proposition: cure the goiter and have left a neurotic patient. It helps if one can evaluate each factor before the operation. A microscopic study of the gland will materially help in forming an opinion before the patient leaves the hospital. Failure to cure a neurosis should not be charged against the surgeon. A careful diagnosis clinically and pathologically will help to make the statistics more favorable to the operative treatment of goiter.

FROM THE CLINIC OF DRS ORR AND THOMSON

## SPECIAL METHODS FOR THE TREATMENT OF FRACTURE DEFORMITIES OF THE FEMUR

BY H. WINNETT ORR, M.D., I. A. C. S., LINCOLN, NEBRASKA

I. H. L. I. C. I. H. p. 10

**M**ALUNION and shortening occur more frequently in fractures of the femur than in fractures of any other part. Moreover deformity is much more likely to be disabling because of the very important part played by the femur in all activities. In spite of that fact shortening and disability in fractures of the femur have been quite generally accepted as inevitable. Compensation insurance companies are usually satisfied to settle with a patient who has suffered a fracture of the femur on the basis of from 10 to 5 per cent disability and are thankful if there is no more disability than that.

In compound fractures permanent disability has been considered to be almost unavoidable. In the opinion of the present writer this is largely for the reason that considerations of wound treatment have been permitted to interfere entirely too much with methods of treatment for the fracture itself.

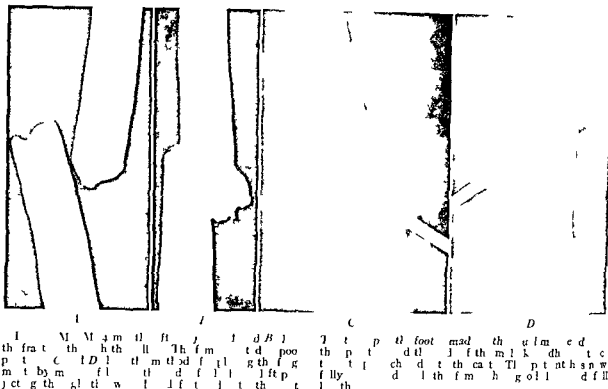
In compound fractures splinting methods and particularly our best splinting methods have been made subservient to wound treatment and consequently immobilization in correct position has rarely been carried out. This leads to a high percentage of patients with malunion and shortening. Many of these patients come to the hospital late for secondary care. Quite commonly even those with severe disability are discouraged in their search for relief and a large number are turned away to carry on with their deformities and disabilities because of the difficulty of the late correction of such conditions.

Since a considerable number of surgeons were familiarized during the war with the use of fixed traction Thomas splints, ice tongs, etc., correction is being done more frequently than previously. Even plastic lengthenings of the femur are being done by some experts. These operations are not being done, however, to the extent that they should be. Plaster of Paris has not been used as much as it should be partly because of the perfectly proper objection that with the ordinary methods of application length is difficult to maintain.

The application of plaster with the idea of securing proper position of the fragments by con-

striction at the point of the fracture is quite wrong. Neither should constriction at the foot be used in an effort to maintain length. In pursuit of a method to render plaster more efficient in maintaining length and to avoid motion of the fragments we have worked out a technique for the application of fixed traction in plaster that overcomes all of these objections. We do not hesitate to refracture either by the open or the closed method almost any late case of femur deformity. Direct manipulation of the fragments is sometimes done by means of pins as illustrated in Case 1. In other cases we depend upon traction alone with fixation of the lower fragments of the femur by ice tongs and in still others the careful application of moleskin adhesive traction with the lower ends of the straps imbedded in the cast. This gives fixation with full length as well as satisfactory immobilization of the fragments. It is never necessary to have undue pressure upon the knee or upon the foot or constriction of the cast at the point of fracture. Both the patient and the fractured extremity are kept under complete control by means of adequate fixed extension in the plaster cast. The details of application are as follows:

First the patient is placed upon a traction table and by means of a muslin bandage about the foot and attached to the traction device at the foot of the table traction is made upon both legs with the perineum firmly against the upright post of the traction table until full length and position can be maintained by the pull on the foot alone. Second the knee is raised by means of a pull against the overhead bar with thick padding underneath the knee until the knee is flexed about 90 to 30 degrees. Now the screw at the bottom end of the table is gradually tightened and the behavior of the fragments at the point of fracture is observed. If by traction and manipulation alone the femur can be brought down to correct alignment and full length nothing more is required. Mole-skin adhesive straps are applied to the limb on both sides extending from above the point of fracture to the malleoli. These mole-skin straps are bandaged on by means of sheet cotton and a firm muslin bandage applied over



that The other limb is similarly bandaged except that no moleskin plaster need be applied. A double plaster of Paris cast is put on up to the arm pits with a cross bar and while cross bars between the legs.

When the plaster has been finished down to just above the malleoli and has set the lower ends of the moleskin traction straps are turned back over the edges of the cast and fastened into the cast by additional turns of the plaster bandage. In this way one locks the traction while the foot is still being firmly held in traction by the muslin bandage.

When the entire double spica has set down as far as the ankles the traction by the muslin bandages on the feet may be released. It will be observed that the leg does not jump back into the cast as is the case in the ordinary cast.

Now the foot may be brought to a right angle and after having been covered with cotton is included in the cast in correct position. The position of the fragments may be checked on the traction table if desired either by the fluoroscope or by X-ray plates taken at the time. If correct position cannot be obtained in this way open operation should be performed and the fragments brought into correct position by means of levers or some other means. A bone graft may be inserted but this is usually not necessary.

In many cases of open operation fixation of the lower part of the fragments by ice tong may be preferred to the moleskin traction method. In such a case traction is applied to the foot as already described and the knee is supported in the same manner except that the bandages should be kept out of the way of the condyles so that there may be no interference in the placing of the ice tongs. After position of the fragments is obtained by manipulation through the incision pins may be employed if desired as in Case 1.

To maintain the fragments in position for the time being the wound is closed in the ordinary manner the pins are left extending out far enough beyond the skin so the ends of the pin may also be included in the cast. Without disturbing either the traction on the foot or the support of the knee the condyles are prepared to receive the points of the ice tongs and these are driven in. No traction need be made on the ice tongs. While traction is not necessary gentle traction may be used if desired and the lower fragment of the femur may be gently supported by means of a pull either longitudinally or forward upon the ice tongs. Care should be taken that the handles of the ice tongs do not rest upon the crest of the tibia below the knee.

Now the operative incision in the skin at the point of fracture and at the point of insertion of



Fig 2 H H D Dudley's patient A Condition on June 20 1927 about 10 months after injury B Condition on September 21 1927 All sinuses and operation wound were healed Patient was able to walk in caliper splint and with crutches

the ice tongs must be carefully covered with sterile dressings and a double spica put on in the same manner so that the ice tongs are embedded in the cast and made a part of it In the same manner as before the cast is carried down to be low the ice tongs and when the plaster is set the release of the foot where traction is being made by muslin bandages may be done without any disturbance of the fragments of the femur either as to shortening or rotation There is no jumping back of the leg into the cast and the foot can be put in correct position and the cast finished without any disturbance of the fragments of the fractured femur

In this manner perfect length accurate position as to rotation and complete immobilization are obtained The traction need not be disturbed for weeks and recovery with the parts in correct position is assured

I wish to report the following case which was operated upon with Dr F H Dudley and Dr Roger Anderson in Seattle Washington in June 1927 As to operation and after care the conduct of this case was identical with many other cases that we have treated in a similar manner

Mr H H 4 years of age sustained a compound fracture of the femur in July 1926 Several operations were performed but in June 1927 he presented the following condition



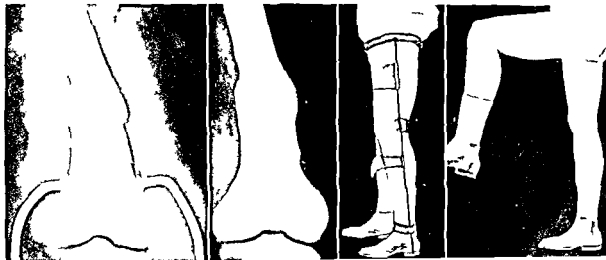
Fig 3 Compound fracture with osteomyelitis and deformity 4 months after injury Saucerized and deformity corrected at the same time Soundly healed in good position 3 months after operation Only 2 dressings were applied Mole skin adhesive plaster fixed in the cast at the ankle was used for traction

There was marked outward and backward bowing of the femur in the middle third The limb was about 2 1/2 inches short There were two large sinuses draining freely through scars on the anterior and posterior surfaces of the thigh



Fig 4 Showing traction and fixation of the lower fragment of the fractured femur by ice tongs embedded in the plaster cast The ice tongs were left in for 4 weeks End result 7 years later The patient was 62 years old





# GASTRIC EXCLUSION

BA H B DIVINE M S F A C S MELBOURNE AUSTRALIA

Honorary Surgeon to St Vincent Hospital Melbourne New Lecturer in Surgery Melbourne University

THE technique of gastric exclusion was reported in SURGERY GYNECOLOGY AND OBSTETRICS in January, 1955. The principle of it is that provided the pylorus is patent one half or more of the distal part of the stomach is excluded and left in continuity with the duodenum. In my later cases I have made the section of the stomach obliquely (Figs 1 and 2) so as to include more gastric canal and exclude more gastric fundus with its acid producing glands. The oblique section also insures a greater intestinal alkaline regurgitation better gastric emptying into the distal segment and a more manageable intestine like excluded segment.

The method of exclusion depends on the circumstances. It may be carried out by an anastomosis as after the fashion of a Billroth II or a Polya or by the modified Polya anticolic method of Balfour. The more of the stomach that is excluded the greater and the more uniform the reduction of acid the quicker the emptying time and therefore the more consistent and better the result.

That the excluded segment gives no trouble but contracts somewhat and remains empty was shown at secondary operations on two patients about 12 months after the operation for partial gastric exclusion that there are no bad effects from it was manifest from the symptomless post-operative course of the patients on whom it was done. The closure of the excluded segment which is peculiarly easy is the only addition to the technique of a gastro-enterostomy and this is amply compensated for by the absence of untoward unforeseen uncertain effects often obtained in the double-exit stomach resulting from gastro-enterostomy. Gastric exclusion is an operation which was not designed for routine use but for special application in certain cases. In a few special instances no other operation can attain its possibilities both as regards lessened risk and permanent cure.

In what follows I shall attempt to define the precise application of gastric exclusion and to set out the particular kind of gastric or duodenal lesion in which I have found this operation of special use.

## DUODENAL ULCER

In very old duodenal ulcers so great may be the callus and tumor formation that healing will

not take place with the simple drainage and reduction of acid which gastro-enterostomy gives. The tissue is so damaged and thoroughly infected that even if healing does occur the infected area never really recovers its original vitality. In addition the scar tissue retains a residual infection which under the influence of some general or local depression of resistance even years after a gastro-enterostomy may cause the development of an acute ulcer in this old scar and produce fatal haematemesis.

If the ulcer is penetrating and situated on the posterior duodenal wall healing is even more intractable. This class of duodenal ulcer is usually associated with a very high acidity and judging from our own clinical experience and modern experimental work the ulcer is undoubtedly caused by this high acidity from the very outset. Gastro-enterostomy is notoriously uncertain in bringing about reduction of acid and it is doubtful if the most ideal gastro-enterostomy can adequately reduce the very high acidities in this type of case. So that in the circumstances—high acidity and old ulcer—to do a gastro-enterostomy is not in keeping with the best principles of treatment and is to invite failure sooner or later. Gastro-enterostomy combined with the removal of the very diseased old ulcer gives more prospect of permanent cure but it is often almost impossible and even if possible very dangerous to remove some of these very old duodenal ulcers and even if resection is possible the gastro-enterostomy may not adequately reduce the high acid. Finsterer would do a partial gastrectomy and duodenectomy in order to accomplish these ideals. We would do a partial oblique gastric exclusion which avoids the dangers of partial gastrectomy and the greater ones of partial duodenectomy and obtains the same uniform and consistent reduction of acid as does a partial gastrectomy and by permanently excluding the diseased area the same certain and permanent healing of the ulcer.

Gastric exclusion was done on 18 patients suffering from duodenal ulcer of this type. One very weak patient died as the result of the operation. Three patients were operated on by Mr R C Brown surgeon of the Alfred Hospital Melbourne who has kindly permitted me to publish the results. He says: "They are the best results I have had from any operation for duodenal ulcer."

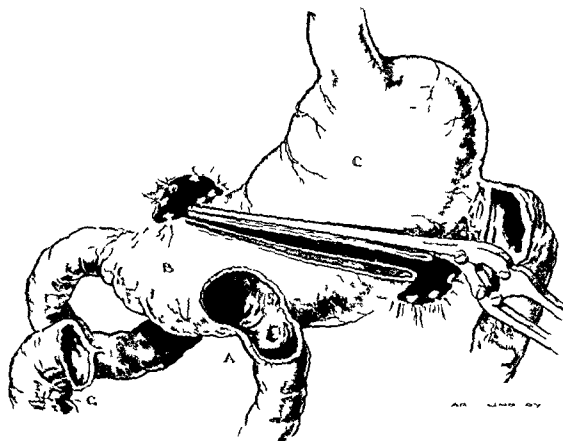


Fig. 1. The illustration shows the operation of gastroenterostomy. The stomach is divided 4 inches from the pylorus. The patients are back at work, have no symptoms, whatever are putting on weight and can eat anything.

If your operation will relieve the mind of the surgeon of the anxiety of gastroenterostomy, it will be worth while and as far as my experience goes it does so. In these patients Mr. Brown divided the stomach 4 inches from the pylorus. He says: "The patients are back at work, have no symptoms, whatever are putting on weight and can eat anything."

Besides being particularly suited to very old ulcers or those associated with very high acidity, gastric exclusion will save much anxiety and heartburning to the surgeon if he uses it in place of gastroenterostomy in duodenal ulcer in women even though there is not a high acid. The female stomach with its low gradient, a term borrowed from Alvarez, lacks the physiological essentials necessary in gastroenterostomy and this hypotonic stomach with its double exit allows excessive intestinal regurgitation which not infrequently causes nausea, flatulence and other

very unpleasant symptoms. The exclusion which is generally made a little nearer the pylorus in women with its single exit in our experience never gives any of these unexpected by effects.

#### BLEEDING DUODENAL ULCER

Under this heading the problem of a very different nature may be presented. In the first bleeding may occur in a very old ulcer from erosion of a fair sized artery. Here resection of the ulcer in addition to a gastroenterostomy is called for but is not always practicable. In one very exsanguinated patient an oblique exclusion as in Figure 1 was done after a transfusion with immediate success and so far permanent cure.

In the second the bleeding may come from recurring acute duodenal ulcer and it will generally recur after a gastroenterostomy. Here probably the exclusion of the ulcer-bearing area is more important than any reduction of acid.

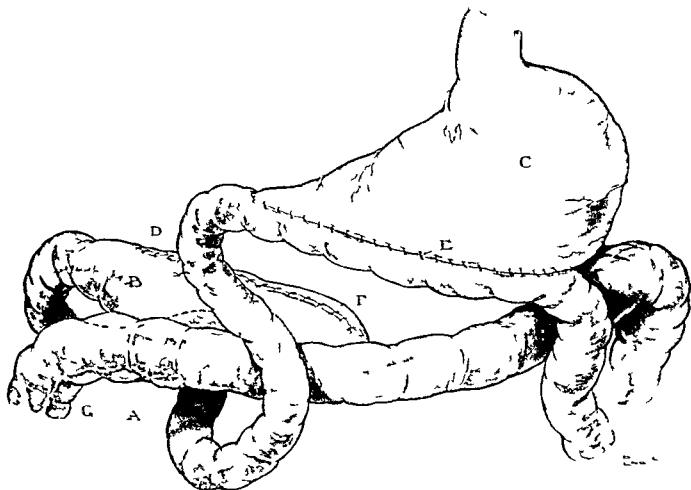


FIG. 2. Second stage of oblique partial gastric exclusion for jejunal ulcer. 1. Gastroenterostomy (B) and jejunal ulcer (A) excluded segment (E) oblique anastomosis (C) which avoids kinking and insures regurgitation where the afferent loop enters the stomach. Similarly the almost transverse position of the intestinal loop removes any tendency to angulation and facilitates emptying into the efferent loop (C) portion of stomach to which anastomosis is made (D) jejunum anchored to excluded segment (E) to prevent angulation (F) suture line of excluded segment (G) transverse colon

# PREPYLORIC ULCER TUMOR

It is not uncommon to meet with a large inflammatory tumor in the prepyloric region of the stomach. This generally arises from a penetrating ulcer and has extensive adhesions to vital structures in the vicinity. It is very difficult and in some cases impossible to remove such a tumor and when it is associated with a chronic perforation as it sometimes is this tumor presents almost insuperable difficulties to operative removal. In addition patients with these ulcer tumors are very sick, cachectic and emaciated either because such an ulcer causes great debility or is prone to occur in very feeble persons so that it is obvious that there is not much latitude for the necessarily extensive operative manipulations.

The following is a history of such an operative gastric problem.

A male aged 50 years had been sick for many years with pain hours after meal. Latterly he developed in

ten the epigastric pain and had finally become very ill and rapidly lost weight and became erythemic. He appeared to be suffering from late gastric carcinoma. He collapsed in my rooms when he had a pulse of 130 and a tender and rigid epigastrium.

Operation disclosed a very large inflammatory and apparently irremovable prepyloric tumor which had formed around a penetrating ulcer with a small chronic well localized perforation. Of course partial gastrectomy was indicated but the patient's condition would not permit of this even if removal were possible so a partial gastric exclusion was done in 40 minutes with no difficulty whatever. The patient quickly improved.

Our experience has been that gastro-enterostomy would be quite inadequate in such circumstances and could not be depended upon to give the same consistent and permanent result.

A second patient treated in a similar manner gave a similar satisfactory result.

It is here interesting to note that although the symptoms were at once relieved I should judge from observations on the local condition that it

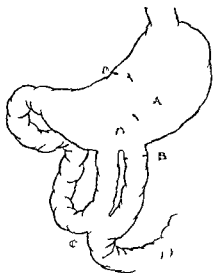


Fig 3 D ammat k th h g l t l g t s  
l o fo j u l l th t t m B  
G to nt t my t m th j j l ul -d tt l l  
h w wh j u m w d d d t t m  
f u f t m h p o l y l t d D F t  
w f o ed

took about 3 months for the very chronic ulcer to completely heal

The statement has been freely made that carcinoma develops on such ulcers. If this hypothesis is accepted this operation may be regarded as a first stage preparatory to a later easy and safe removal of the healed ulcer area. But much recent pathological work appears to throw considerable doubt on this. The fear of cancerous degeneration of the ulcer then may be advanced as a strong argument against gastric exclusion in these very sick patients.

#### HOURLASS STOMACH

The great weakness of the patient was the main indication for gastric exclusion in an almost complete hourglass stomach on which it was done.

The distal sac was disconnected and closed and a Billroth II was done a quick and easy operation. The patient is in perfect health after 12 years and has never had a symptom so that from this it may be deduced that the excluded segment of the stomach does not produce any symptoms.

#### JEJUNAL ULCER

It is our experience that exclusion is of inestimable value in a few very weak patients suffering from jejunal ulcer. It has been and still is our custom to remove the jejunal ulcer by an enterectomy and partial gastrectomy but this may not be prudent in jejunal ulcer with profound

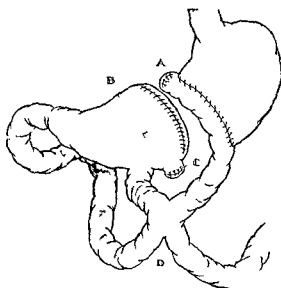


Fig 4 l f l f l p f m g t o e t e t m y t m a  
l l l l th l l d d th l p b ht p beh d  
th l p to b t m d w th t m a h B G to  
rt o t m v t m ( th j j l l ) d a n l d d  
g m t c f l t l p f m g a tr t t m t m  
d d d d lo d D t a s t m

bleeding and with innumerable and cartilaginous adhesions resulting from many operations and especially if there is great debility or if in addition the ulcer is in an old person. The risk is grave in such circumstances and may be avoided. In these patients it is an essential principle that more than half or perhaps two thirds of the stomach should be excluded in order to reduce the acidity sufficiently and so as to keep clear and well to the left of the jejunal ulcer and the adhesion area. This can be accomplished only by making the section of stomach obliquely as in Figures 1 and 2 and the anastomosis of the jejunum to stomach by the antecolic Polya method of Balfour.

The following are histories of patients who were operated on by this method.

C SL B m l 5 v had b p t d  
f t m f j aal l T l h d b p at d l  
r t d d th tom l g d H a y w k nd  
l b l tat d d u t d Op r t d loed l c  
j j l l ad j nt t m l olon tr r m  
j m l l t t t d t m t r y l f o m g  
t m m h b of th m ny p t d th  
t l l m m l l l f l b t t th  
tru t l t e 4 p t l g t t m y d t t  
t m t l um t w l h b n m t d d l t  
t d th p t nt t d g f  
Th l l t t th l f t f th p  
a s d w l t th l f t f l h pr pe two  
d b l l dh n l w r k ng n t m h d  
nt t e p r f m d p t a l g tr l u n (F

1 and 2) Three years later this man was in perfect health and had gained two stone in weight. He has never had a gastric symptom since his operation.

CASE 2. Male aged 73 years was a very sick man indeed. He had had three operations—one of them a small partial gastrectomy—for jejunal ulcer. Operation was thought inadvisable because of his age and general condition but as he was in great agony a gastric exclusion was decided upon. This was quite easily tolerated and gave immediate and complete relief. Two days after regaining up and 3 weeks after the operation he dropped all food from heart failure probably as a result of dissection of the coronary arteries.

CASE 3. Male aged 55 years. This patient had a history of duodenal ulcer for 20 years and was one of the worst I have ever seen. During the last 6 of the 20 years he had three operations upon the stomach by three different surgeons without relief. Severe pain, vomiting and frequent copious hæmorrhages had reduced the patient to a state of misery and weakness. He lived in daily terror of hæmorrhage through which he had been almost exanguiated on three occasions. He was extremely pale and the upper part of his abdomen showed laparotomy scars. Radiographic examination disclosed jejunal ulcer. Operation revealed his stomach and bowel tangled in a confused mass by adhesions. Separation of the duodenum from the old gastro-enterostomy and entero-anastomosis with jejunal ulcer at the site of the former. The patient was so ill and the state of his upper abdomen so terrible that it was considered wise not to explore the duodenum. The jejunum was divided just distal to the jejunal ulcer and both sides closed. Somewhat more than half the stomach was excluded and the remainder anastomosed into the distal piece of jejunum (Figs 3 and 4) thus side tracking the ulcer and leaving it in a blind end, the old entero-anastomosis remaining for the passage of the duodenal juices. The patient 2 years later had quite recovered, had gained weight and had no gastric symptoms.

It is conceivable that the retention of the entero-anastomosis decreasing as it does intestinal regurgitation might predispose to a recurrence of the ulcer but under the circumstances it was difficult to do otherwise.

#### BLEEDING GASTRO-ENTEROSTOMY

After gastro-enterostomy a patient may suffer from repeated severe hæmorrhages without the symptoms of chronic jejunal ulcer pain may be entirely absent. The patient may be quite well in the intervals. This bleeding which has its analogue in the bleeding duodenal ulcer probably arises from an acute recurring jejunal ulcer. It is difficult to know how to treat these patients. Partial gastrectomy is indicated but must be extensive and therefore unnecessarily mutilating in order to accomplish its object. For these I have performed extensive gastric exclusion with great satisfaction and very little disturbance.

In these cases I invariably make the section of the stomach very obliquely (Figs 1 and 2) so as

to include more of the gastric canal and exclude as much as possible of the fundus and its acid producing glands. As I place the distal part of the jejunum to the greater curvature the obliquity also insures greater alkaline regurgitation. As the excluded segment is drained by the first gastro-enterostomy stoma it can be made very big. Here is an example of such a case.

He aged 50 years. This man had symptoms of duodenal ulcer. He was operated on a duodenal ulcer was found and a posterior gastro-enterostomy was done. For the last 4 years since his operation he has had severe attacks of hæmatemesis and melaena one of which he nearly died. He has never had any pain after meal nor any other symptoms of chronic jejunal ulcer except perhaps an acidity which generally preceded an attack.

An extensive oblique partial gastric exclusion was then done.

Here it was possible to make a valuable comparison of the fractional test meal and emptying time of partial gastric exclusion with the gastro-enterostomy where both the operations were done on the same patient.

Fractional test meal—hour readings

Bleeding gastro-enterostomy Free acid 10 45 55 20-  
Emptying time 1 hour

After exclusion Free acid 0 0 0 0 0 0 Emptying time 10 minutes

This is quite typical of the results we have obtained in several of these cases and clearly shows that partial gastric exclusion gives a much quicker emptying time and a very much greater reduction of acidity than does the operation of gastro-enterostomy.

While it is not possible yet to furnish reliable remote results in the 40 cases operated upon some general conclusions may be drawn. The results are just the same as for a partial gastrectomy of the same extent. Like partial gastrectomy for duodenal ulcer if gastric exclusion is too limited there is danger of the occurrence of jejunal ulcer because there is insufficient reduction of acid. Where from one half to two thirds of the stomach has been excluded in the oblique exclusion a uniform and satisfactory result both immediate and remote has been obtained. In fact it will give the very same results as Finsterer's partial gastrectomy and duodenectomy for duodenal ulcer with half the operative risk. As far as experience goes this operation has been found to be practically free from any unpleasant after effects that often attend gastro-enterostomy and is an extraordinarily useful operation to as it were have up one's surgical sleeve.

SURGICAL RESULTS IN PEPTIC ULCER<sup>1</sup>

BY J. TATE MASON, M.D., F.A.C.S., SEATTLE, WASHINGTON

**D**IVIDED opinion as to the merit of gastroenterostomy for peptic ulcer is current because both satisfactory and unsatisfactory results have been reported by capable surgeons. With this in mind a study of the records of the patients who have been operated upon by us was begun and while our group is not large we have tried to make up for the small number by an accurate personal investigation of most of the cases. This study has revealed some matters of interest in connection with this particular operation which may be worthy of note.

Blackford and Dwyer made a study at our clinic of 2500 consecutive histories of patients complaining of gastric symptoms and found that only about 1 out of every 7 cases received a diagnosis of organic lesion of the stomach and duodenum. Only 1 out of every 3 cases diagnosed as gastric or duodenal ulcer came to operation. In other words only about 1 out of every 21 of these patients who came in thinking that they had some organic lesion of the stomach and complaining of what they thought were symptoms of such disease really came to operation for peptic ulcer. One hundred and twenty-five gastric and duodenal lesions have been treated surgically of which 27 were gastric ulcers and 81 were duodenal ulcers.

In this series the histories were all written and the physical examinations were all made by competent internists. The average age of males with duodenal ulcer was 40 years, the average age of females 43 years. Duodenal ulcer occurred in about the proportion of 3 in the male to 1 in the female. The age of males with gastric ulcer averaged 48 years and of females 47 years. Here again the proportion of male to female was about 3 to 1 in number.

The histories alone in 80 per cent of these cases pointed conclusively to peptic ulcer. There was the story of hunger pain. In fact pain was the predominating symptom of peptic ulcer. This pain was usually present from a few days to a few weeks with complete or practically complete remission of symptoms for months. It was usually one of three distinct types. The first type of pain due to intragastric or intraduodenal lesion was that due to excessive peristaltic action. In these patients sharp peristaltic waves follow each other. The increased peristalsis results from the increased secretion which is the result of the irritation produced by the ulcer. The next most frequent pain

of which patients complained and described as a gnawing sensation is due to the action of the hydrochloric acid upon the base of the ulcer. The third type of pain and that which is usually the most distinct of all is that of impending perforation with associated acute inflammation in and about the base of the ulcer. This pain often simulates gall stone colic and is not relieved by soda or food as are the first types mentioned.

Tobacco habit has been noted in most of the histories of the male patients. Vomiting occurred in about 60 per cent of the cases. Hemorrhage varying in amount from very slight to very large occurred in about 25 per cent of the cases. It has been noticed often by other observers. The majority of these patients complained of acute exacerbations of symptoms in the spring and fall.

There was a small group of patients from whom practically no history of gastric symptoms could be obtained and in this group some of the ruptured gastric and duodenal ulcers occurred. These patients gave absolutely no history of trouble up to the time of perforation. However on rechecking these cases some very good histories were elicited.

Next in importance to the history was the roentgenological evidence. In this group of cases there were positive errors of the roentgenologist in operative cases, i.e. a roentgenological diagnosis of ulcer was made but no ulcer found at operation. Negative errors numbered 10, i.e. a negative roentgenological diagnosis was made but ulcer as found at operation. This was a total positive and negative error of 15 out of 104 patients who underwent operation. The errors were as follows: 1 positive error and 3 negative errors for gastric ulcer and 4 positive and 7 negative errors for duodenal ulcer, a total gross error of 14.4 per cent. Duodenitis was definite in 3 patients listed as 3 of the negative errors among the duodenal ulcer case.

Acute perforation occurred in 15 patients. Four died of these. 2 were operated upon 4 days after perforation and 1 was operated on 8 days after perforation and a woman 70 years old was operated upon at 6 hours. Three patients with perforated gastric ulcer who were operated upon within 4 hours recovered.

There have been 15 operations for peptic ulcer upon 118 patients. One sleeve resection was done but the final results were not satisfactory. Gastroenterostomy was performed 2 years later with

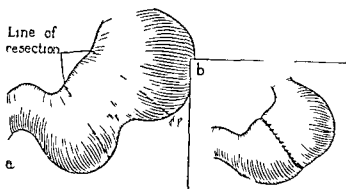


FIG. 1. Sleeve resection. The final result was not satisfactory. Gastro enterotomy gave relief but the patient died later of cardiovascular break.

complete gastric relief. The patient died later of cardiovascular break. Two Horsley operations, 4 Finney operations, 4 Polya-Balfour operations, 7 Judd operations, 16 excisions, and 90 gastro-enterostomies were done. Of the patients who were submitted to the Horsley operation both have done well though 1 had a very stormy convalescence. After a Finney operation 1 patient made an uneventful recovery while 3 had a considerable amount of immediate postoperative trouble. One of these had persistent vomiting which was finally controlled by daily gastric lavage with a very weak solution of nitrate of silver. One had a duodenal fistula which finally closed spontaneously. The final results in these cases have been satisfactory. The 3 Polya-Balfour operations all gave satisfactory results except in 1 patient with syphilis of the stomach who died of pernicious anemia 4 years after the operation. Seven patients who had the Judd operation had a very even convalescence in the hospital and while the period of observation is shorter than that of any of the gastric operations the results have been most satisfactory up to the present.

Of the 91 patients upon whom gastro-enterotomy was performed for peptic ulcer we have been able to communicate personally with 70. A physician spent from 15 minutes to an hour discussing with each patient his present condition. Of the 21 remaining cases, 11 died and 10 have been heard from indirectly through friends who have seen them within a year and a half after their operation.

We are most interested in the number of deaths and the poor results in comparison with the good. Following is a list of these results. There were 4 hospital deaths or 4.4 per cent. One of these patients made an uneventful recovery but died from pulmonary embolism on the fourteenth day as she was leaving the hospital. One died on the tenth day from a complete separation of the

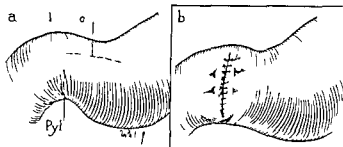


FIG. 2. Horsley operation. The final results of 2 Horsley operations were satisfactory but 1 of the patients had a stormy convalescence.

gastrojejunal anastomosis. In this operation no non-absorbable material had been used. The anastomosis had been made by especially prepared catgut welded onto a straight needle. This we had thought would withstand the digestive action of the gastric juice. At the postmortem absolutely no catgut could be found even the knots having been absorbed by the tissues. The third patient died on the third day from pneumonia. The fourth died on the sixteenth day from postoperative insanity. A postmortem examination showed that the gastro-enterostomy opening had functioned normally and that there was no peritonitis. There have been 8 late deaths in this series, 2 from what was undoubtedly perforation of a gastrojejunal ulcer.

There have been 10 poor results, that is 12.6 per cent of the number of living patients have not had entirely satisfactory results.

Two patients each had a large postoperative abdominal hernia. In a third case the anastomosis had to be disconnected on the seventh day because of persistent vomiting. It was found that the mesentery of the transverse colon had slipped down over the proximal and distal loops of the jejunum. This patient continued to complain of his stomach symptoms for about a year when another gastro-enterotomy was performed. This has since functioned satisfactorily although the patient still complains of some symptoms.

In a fourth patient the anastomosis had to be disconnected on the fourteenth day because of persistent vomiting.

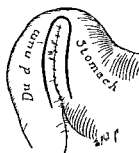


FIG. 3. Finney operation. The final results were satisfactory in the 4 patient on whom this type of operation was performed but 3 of them had a stormy convalescence. One had a duodenal fistula and another vomited persistently.



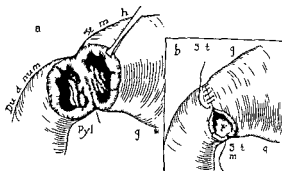
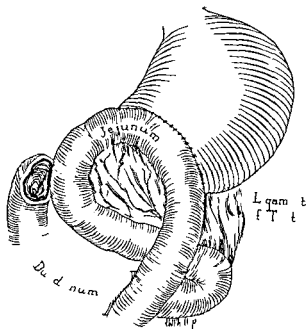


Fig 3 J dd op t Th typ f p t  
p f m d c nd th lt w p t f t r y  
v r t 3 m th p t p t ly

TABLE I RESULTS OF ONE HUNDRED AND TWENTY FIVE OPERATIONS FOR PEPTIC ULCER

N	T p e f	R l
1	Sl	t t f t y Gat t t m v y lt m p l t g t r i f D th f m d l b k t fact y t my n l e I l l t t f t y
4	I y	t f t y 3 t my le p t t om t g d d l f i l f l lt t f t r y
4	I ly B lf	3 t f t y yph l t l t a i l th t t l t m h D d 4 y l t f p n a m a S t f t y y t 3 m p t p t 5 p t t f t 4 h p t l d th [4 4] f m m b h m 4 d y f m p t f g a tr j j al a t m d y f o m p m 3 d y f m p t p t t y o d
6	E c t l	9 l t d th f m t pp d t f m p f t t t t t t l 4 fr m n l t y t m h y m p t m f m du l b k 9 l 7 r m m t d w th p lly 8 p r t d th h f r d
9	G t o t t m	

The first and second patients each had no operative hernia but are very comfortable with snug fitting belts and no second operation seems advisable. There have been 3 patients operated

Fig 4 P ly B lf p t I 3 th lt  
w t f t y A f th p t th l yph l t l  
t d l th l t d t m h d l l 4 y e l t f  
p a m

ng I th t l th m t f th t  
l had l p p d d th t m l d d t l l h o q  
f t l j j m Th d d l l l d l d t t h  
t t p t Th f t t l l m p l f m 6 t  
v m p t

A f h t p t t t d t m p l f p d l  
m f t S t n t h f t t p t l p  
t my wa a p f m d t h t m m y p l  
d l d p y l d h w f l Th h t  
m p l t l f th d p t a  
Th th p t t t n d d l w h j y s l l  
h l th It m m p b l t m k h l m t t h t y  
p t f h t m y f t p p l y Sh p l b l h  
k t j j l l  
I th th l h t l g t j j u l l  
w d d th a t m d t l w th o m  
p l e t l f  
Th th p t t f f d f m a g s t j j l l  
l t th l w l d t l l d p e t t  
b p r f m d  
I h t n t h p t t n t h u t f t y l t l t l  
S t h m h l e p o l l t t t d t f h  
u t y S m h wa p r t d p l  
wh f d d l u l d g a t t t m y w  
p f m d Sh w f l y c m f t b l f b t o m th  
h th l d g n w m f t b l t r t d  
Sh f f d f m t h f 8 y Tw y e s g w d  
t d th t t t t m y a d d k t  
j j u l l Sh a f l y c m f t b l f b t s  
m n t h f t th d t h t d w t h y m p t m n d  
n t s l g l f d g f d t l l Th t t  
l c e w h h w d d l th n d w h h w s g t  
j j l d th th d u l h c h d d l d h h  
h h h h l l p t d t f c f t h m t  
f l m d l m m t t h t l d l a p t d Th  
p t t h f d th d p t

upon with complete relief (the fifth seventh and eighth patients) which brings the unsatisfactory results to 3 cases or 6.9 per cent of those living. Of 49 gastro-entero tomies which are functioning satisfactorily and all of which were done from 1 to 10 years ago gastrojejunal ulcers have been traced in only 6 cases or 12.2 per cent.

#### TEN CASES 12.6 PER CENT NOT ENTIRELY SATISFACTORY

Case 1 and 2 postoperative abdominal hernia (1 m fortible with abdominal belt).

Case 3 disconnected on seventh day. Mortality of transverse colon slipped down over proximal and distal loops of jejunum.

Case 4 disconnected on fourteenth day because of peritonitis vomiting.

Case 5 pain and discomfort. Operation was done 18 months later. Many peritoneal and peritoneal adhesions.

Case 6 gastrojejunal ulcer disconnected. Relief.

Case 7 gastrojejunal ulcer disconnected. Relief.

Case 8 gastrojejunal ulcer disconnected. No relief.

Case 9 gastrojejunal ulcer.

Case 10 gastrojejunal ulcer.

#### FIFTEEN PERFORATIONS

There were 4 deaths in 15 cases with perforation. Of these two patients were operated upon 4 days after perforation, one 8 days after perforation and one a woman 14 years old 6 hours after perforation of the 15 cases survived.

## THE TREATMENT OF POSTOPERATIVE PROGRESSIVE GANGRENOUS INFECTION OF THE SKIN AND SUBCUTANEOUS TISSUE WITH BLOOD FROM IMMUNIZED DONORS

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F. M. H. S. G. I. J. H. H. I. I.

THE object of this paper is to report a case of an unusual infection of the skin and subcutaneous tissue following incisions for the drainage of an acute breast abscess.

In recent years this type of lesion has been studied and reported by Frederick Christopher (3) Thomas Cullen (4) Brewer and Meleney (5) and Emory Alexander (1). At the American Surgical Association meeting of 1926 similar cases were reported by Charles A. Porter of Boston who referred to 3 cases seen at the Massachusetts General Hospital (5) Alexis V. Moschowitz of New York reported cases that he had seen and Marshall Clinton of Buffalo mentioned 1 case that he had studied. Arthur Marriott Shipley of Baltimore reports a case he had treated at the University Hospital (6). These contributions appear to make up the total recent literature on the subject.

The etiological factors in this type of progressive gangrene are not specific. One fact seems to be most impressive namely in each of the cases reported the patient had been very acutely ill with an infection requiring surgical intervention which was in turn followed by a spreading gangrene.

The organism found in the various cases has varied greatly. The instructive work reported by Meleney (2) discusses the bacteriological findings of their cases in detail. The bacteriological work in our case was done by Downey Harris.

The phrase progressive gangrenous infection describes the lesion most accurately. The first thing to attract attention is an unusual brownish dark red appearance of the skin surrounding the original site of operation. An accompanying elevation of temperature would seem to indicate that one has to deal with an exacerbation of the original infection. A second incision is made for the sake of better drainage but its edges are soon undermined and show a tendency to necrosis sloughing and gangrene.

The undermined skin is free from the subcutaneous tissue and a purulent secretion exudes from the advancing necrotic area. The edges of the wound bleed very easily but are not noticeably tender. In a variable period of time extending from several days to 1 or 2 weeks another area of hyperemia develops. Another dark purple discolored border appears and a new advance in the gangrenous field is seen. The hyperemic area is at first somewhat tender but not unbearably so. As the gangrene advances leaving a raw granulating surface the tenderness associated with this open wound becomes most exquisite. The infection spreads in an even fashion extending around the margins of the wound first making itself evident in one site and then in another. The entire border of the wound actually becomes a spreading phlegmon.

The patient is not made unusually ill by each flare up of the infection except as the condition



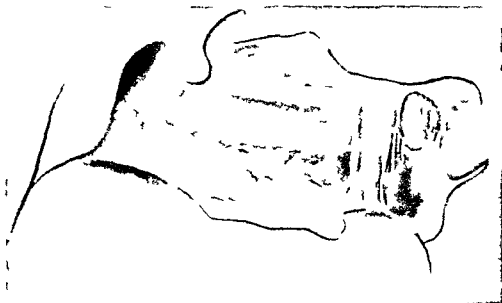


FIG. 2. Detail drawing of the wound in Figure 1 showing the denuded sternum and ribs exposed.

pulse was 13. Later Tuholke was called in on ultimate thinking that the infection had spread into the other quadrant or that our first attempt at relief drainage had not been successful. We decided to incise over the newly inflamed area. The patient now looked ill (as anesthesia was again administered and the breast of the pus bowed staphylococcus. Irrigation with Dakin solution was started. At this period the patient developed a typical postoperative psychosis which caused great concern. She complained constantly of a severe headache accompanied by irregular waves of chill followed by increase in temperature. The breast was draining freely and we could find no reason so far as the local condition was concerned which would cause her to be so ill. Fearing that some other condition might be concomitant with the breast infection we called Dr. Englebach into consultation.

June 6 no other organic complications as evident. The condition was considered to be due to a postinfective psychosis. The patient was put on luminal and supportive treatment.

June 8 the patient developed a severe chill and nail became cyanotic. A blood culture was negative. Culture from the breast revealed staphylococcus aureus. The patient commenced to complain of a new area of extreme tenderness surrounding the two incisions. The tissue around the old incision looked dark and appeared to be in a gangrenous state. Several other areas in the breast also commenced to look gangrenous. Several days later these new areas broke down leaving discharging sinuses in the breast.

August 10 Dakin's tubes were placed in each of the sinuses and daily irrigation with freshly prepared Dakin's solution were made. No appreciable progress was made inasmuch as the amount of discharge temperature etc. showed no tendency to diminish.

The entire breast now took on an atrophic appearance the color being dark purple. From each of the sinuses pus exuded freely. The margins surrounding the openings were undermined and between several of these openings the skin was entirely free from the underlying tissue. The

patient was unquestionably low ground. Her temperature ran up from 100 degrees to 102 degrees daily with an occasional exacerbation ushered in by a chill and followed by a rise in temperature to 103 degrees. We knew that this was not a primary infection but in spite of repeated cultures no light could be thrown on the situation.

By August 19 the breast took on such an appearance that it was thought best to do a simple amputation leaving all margins open so as to allow free drainage. This the patient refused to permit and insisted on leaving the hospital. After staying at home for a week the patient returned and consented to the simple amputation.

The breast was amputated August 30 incision being made aside of all necrotic tissue. The infection at this time did not penetrate beneath the fascia. All margins were left wide open to maintain adequate drainage. Microscopic examination of the breast by Dr. Olch revealed the following: The specimen No. 10023 consisted of a breast excised with overlying skin. The nipple was retracted. Over the skin were numerous sinus openings from which thin copious purulent material exuded. Section of the breast showed diffuse abscesses. One of the abscesses extended through the breast and lay upon the pectoral fascia. There was no gross evidence of malignant change. Microscopically the breast tissue showed a fairly extensive fibrosis. There was a marked round cell infiltration. Abscessed areas were made up of solid masses of inflammatory cells indicating a progressive sinusitis. There was no evidence of malignancy. A diagnosis of chronic suppurative mastitis was made.

Following the removal of the breast the patient had quit running temperature and the wound drained most freely. However she had become so extremely sensitive that to irrigate with Dakin's solution was out of the question. Solution of mercurichrome saline and boric were resorted to eventually however on the chest had to be discontinued on account of the pain. The wound was left open to the air and periodically baked under incandescent carbon lamps.

September the patient commenced to complain of pain in the area extending down toward the axillary space and it was noticed that the skin there had taken on a red





Fig. 5 (left) Shows the wound 400 days after the first operation. The entire area is healed except close to the axilla where accessory mammary gland formation is a mechanical impediment.

Fig. 6 Shows the appearance of the wound 18 months after the onset of the infection. An area of osteomyelitis is seen over the sternum.

consisted in keeping the wound clean and applying plain vaseline dressings which could now be done with less discomfort to the patient.

May the wound margins were commencing to fill in. The secretion was much less and the patient had gained 3 pounds in weight. May 19 10 pinch grafts from the thigh were transplanted to the wound under local anesthesia and in 10 days it was evident that all had taken (Fig. 4). On May 30 35 pinch grafts were taken from the thigh and placed on the wound. All but 6 took.

June 1 was the first day since the onset of the infection that the patient passed through 24 hours with a normal temperature. On July 5 the entire wound had become covered and healed except for an area where the infection had eroded the sternum and caused an osteomyelitis and another area close to the axilla where an accessory mammary gland formed a mechanical impediment to the complete healing (Fig. 5). The patient was discharged on July 10 after having spent almost 30 days in the hospital.

June 1 1928 the patient's general condition was very good. She weighed 163 pounds and was considering going into business. The wound was practically healed save for a clean granulating area the size of a thumb which still persisted where the mammary gland interfered with complete healing. This we felt would have to be dealt with by plastic surgery at a later date. A small amount of

discharge was seen to come forth from the old area of osteomyelitis in the sternum (Fig. 6).

## REFERENCES

1. ALFANDER F. C. Postoperative pyrexia superficial gangrene. Ann Surg 19 6 xxxiv 461.
2. BREWER GEORGE IMFRSON and MELFNEY FRANK. IACRANT. Pro re sive gangrenous infection of the skin and subcutaneous tissues following operation for acute perforative appendicitis. Ann Surg 19 6 xxxiv 438-450.
3. CHRISTOPHER F. Severe pyrexia carbuncular infection of the chest wall following rib resection under local anesthesia. Surg Clin N Am 1924 iv 95-10.
4. CULLEN THOMAS S. A progressive enlarging ulcer of the abdominal wall involving the skin and fat following drainage of an abdominal abscess apparently of appendiceal origin. Sur Gynec & Obst 1924 xxxviii 579-58.
5. PORTER CHARLES A. Tr Am Surg Ass 19 6 xlv 408.
6. SHIPLEY ARTHUR MARRIATT. Progressive gangrenous ulceration of the abdominal wall. Ann Surg 19 8 lxxvii 45.

# INTES TINAL KINKING

By NORMAN M. GUIOU, M.D., O.T., A.O.T.R.  
A. I. G. S. G. O. C. H. I. I.

AN endeavor will be made in this paper to show by experiment both with tubes other than intestine and with intestine at the autopsy table that intestinal kinking has a definite etiology on which can be based definite prophylactic and therapeutic measures.

Search of the literature reveals nothing in the mode of production of this phenomenon (except the doubtful Lane's kink) but does show that the English surgeon Rowlands previously expressed the writer's clinical views that intestinal obstruction due to kinking occurs following operations and during peritonitis where it is mistakenly called paralytic distention of the bowel.

In the writer's opinion paralytic ileus is a surgical entity does not exist as only the transient intestinal inhibition following peritoneal insult or the last state of an obstructed bowel is of this nature. During the period of inhibition more prolonged in case of peritonitis gas is produced and this inflates the bowel which as will be shown later causes it to kink. Were the bowel not kinked the gas would immediately escape through the rectal tube. Gas pains—the beginning of postoperative symptoms—are due in the writer's opinion to *recoiled* bowel contracting against obstructing kinks. Having consulted scientific friends in a fruitless search for information on kinking in tubes the writer has developed the following conception himself.

Kinking is a phenomenon in which the circumference of a tube tends to flatten to a plane when the tube is bent through the arc of a circle. It can best be understood in its simplest form by taking a half tube of *inelastic* material such as paper (Fig. 1A). It will be seen that *1B* and *1CD* are of equal lengths. If this half tube be bent into a circle it will be seen that *1B* and *1CD* form circles of equal circumferences and therefore *EF* becomes a straight line. If we make this half tube into the arc of any circle no matter how large *EF* becomes a straight line. If now we take a complete tube (Fig. 1C) and attempt to bend it so that the zone *EP* forms the arc of any circle whatever the *two* *hemispheres* straighten out into *two* *straight lines* and a kink is formed. Let us call the line *EF* the *approximation line* of a kink, the convex part of the tube wall over the kink the *cap*, the under part of the kink the *angle* and the double walled partition formed by

contact of the limbs of the kink when the angle is acute the *spur*. The cap at *EF* is held down on top of the spur by the resultant of the force which made the bend there and forcibly occluding the lumen of the tube.

## FACTORS FAVORING KINKING

*The less elastic the tube the more readily it kinks.* If we take an elastic or ductile tube we find it can be bent to a certain extent without kinking as its outer circumference can elongate. It will be seen (Fig. 2B) that *1B* becomes longer than *1CD*. Once the limit of elasticity is reached kinking occurs (Fig. 2C). This can be applied at once to the human bowel. Intestine with its wall stretched by dilatation covered with fibrinous exudate or infiltrated with intramural inflammatory product has its elasticity impaired and kinks readily.

*The larger the tube the more readily it kinks.* This axiom is extremely important for on it the pathogenesis of intestinal kinking largely depends. If we take a large and a small tube and bend them we find that the large one kinks when slightly bent but the small one may be made into a very small circle without kinking. Pumper make use of this axiom in choosing a smaller pipe to make a difficult bend. Plumbing engineers specify how far their pipes can be bent without buckling—smaller sizes bending much further. Collapsed bowel will lie in very small coils without kinking but if the intestinal tube is enlarged by air inflation it readily kinks when held in circles the maximum diameter of which is the inside of the abdomen and the maximum radius of which is the length of the mesentery.

A kink may be *complete* or *incomplete* depending on whether or not the cap is in complete contact with the spur. It may be *free* or have its limbs fixed to either with fibrinous exudate or held by the margins of an aperture between transperitoneal bands, etc.

The normal intestine lies in a series of incomplete free kinks. If the intestinal diameter is increased with gas distention these kinks may become complete and form a series of resistance offering obstacles the sum total of which is obstruction. As a rule the obstruction due to free kinks is not serious and depends readily to treatment and the kinks disappear with the distention. In herbivorous animals however it is

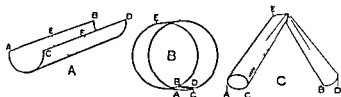


Fig 1 Kinking analyzed

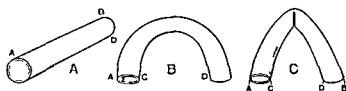


Fig 2 Kinking in an elastic tube

frequently so serious as to require trocar enterostomy and it has been reported by Hunt so severe after kidney operations as to require caecostomy.

### OBSTRUCTION IN KINKS

Factors favoring obstruction in kinks may be conveniently studied with a length of thin walled cigarette drain tubing with one end clamped and an atomizer bulb tied into the other. If the tube is merely rounded out with air it kinks readily. Because of the transparency of the cap the spur can be readily seen. With further pressure by the atomizer bulb the proximal limb of the kink distends slightly then the approximation line which has been straight is seen to arch up in the center and the gas passes the kink. Any factor therefore which will prevent the upward rising of the cap will make the kink more obstructive. Holding the approximation line against the wall makes it totally obstructive. It is highly possible for this to occur in the pelvis. Loss of elasticity at the cap will also keep it from rising. This might result from the stretching of the wall to its limit or from adherent exudate. A kink in a garden hose (traction kink) is totally obstructive at once because of the inelasticity of the wall of the tube.

### PRACTICAL APPLICATION

**Gas formation.** The diameter of the intestinal tube is kept down by preventing the formation of gas. For the first 36 hours after laparotomy patients receive warm water only by mouth then if there is no distention they receive full fluid diet. If there is any tendency to distention however the patients are given acidophilus milk until the tendency has disappeared. The great value of

acidophilus milk was impressed on the writer several years ago by the following case.

**CASE 1.** A farmer was admitted to the hospital 5 days after the onset of acute appendicitis. The abdomen was a mass of pus and fibrinous exudate so that drainage alone was established. Distention set in and increased in spite of frequent doses of pituitrin after which the patient passed much flatus finally on the fourteenth day I re-opened the abdomen. The peritonitis had cleared up but the small bowel was 3 inches in diameter and showed several kinks firmly fixed by fibrinous exudate beginning to organize. The bowel was about the same size on each side of these kinks so they were not completely obstructive. They were freed and the abdomen was closed. The patient was in excellent condition for about a week. After that distention set in again and increased until he was as ill as before with the abdomen greatly distended and tense. Pituitrin still caused some flatus to pass. I reasoned that if we could check intestinal gas formation we might save him. Acidophilus milk was tried with a most spectacular result. In 4 hours the abdomen was flat and patient made an uneventful recovery.

Since then I have given acidophilus milk for several days preparatory to laparotomy. A local dairy makes the milk and patients drink it at home before they enter the hospital. It has worked admirably as a distention preventive. One case in particular in which prevention of distention was very essential illustrated its value—a large ventral hernia which was repaired with living suture fascial transplants. The abdomen with its returned bowel remained absolutely flat and soft.

Thomson Walker and Everidge use the intestinal antiseptic dimol preparatory to kidney operations to prevent distention.

**Intraperitoneal exudate.** Wound exudate especially in the pelvis cements loops together.

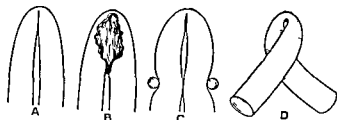
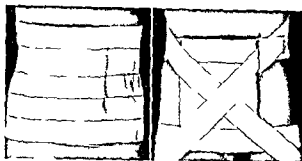


Fig 3 Varieties of kink. A free kink. B fixed kink. C held kink. D traction kink (garden hose kink of doubtful occurrence in the intestine).



Fig 4 Kink at rest and kink with gas passing





I 5 (left) A k k f  
I 6 A t l k d n

type f d n

and forms fixed kinks—the common dangerous variety. Therefore great care should be taken to peritonealize raw surfaces and cover them with omentum. The prompt stamping out of peritonitis with intraperitoneal antiseptics and the raising of the patient's resistance with blood transfusion and ultra violet light baths are also important.

*The dilate! intestinal coils should be left free to form arcs of the largest possible circles. Avoid tight postoperative dressings.* The pelvis as it is the smallest circle in the abdomen must be watched closely as it is a danger zone for kinking. If loops which lie there flaccidly at autopsy are held down with a hand over the pelvic brim and inflated with air they are bound to kink. Loops held in the pelvis by pressure from above or by exudate from intrapelvic surgical wounds are sure to kink if only moderate distention occurs. In the writer's opinion the most likely explanation of Handley's Ileus Duplex is pelvic kinking, and not the fact that the bowel is lying in a pelvic pool of pus as frequently happens with infrequent seriousness. In this connection a popular type of postoperative dressing in which strips of adhesive stretch tightly across the lower abdomen from one iliac crest to the other is not above reproach.

The writer now uses no transverse strips across the lower abdomen but holds the lower end of the gauze dressing with a strip which runs from trochanter to trochanter (Fig. 6) and crosses at the symphysis and not over the pelvic brim. The upper transverse strip is very loosely applied. The adhesive is cut along 120 hours after operation and loosely taped.

*If the gas is blown past the kinks early the kinks will tend to disappear.* The writer uses pituitrin freely and early even in intestinal cases believing that a blow out at an intestinal suture line is less liable to occur from pituitrin on a comparatively healthy bowel than from constant pressure

B. d. W. and d.

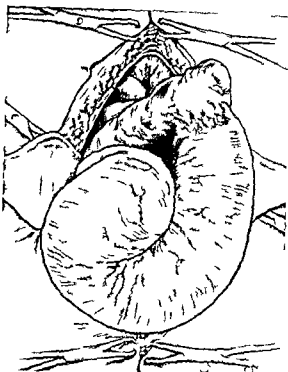


Fig. 7. A bstr. t. f. d. k. k. f. d. at. It. t.  
l. p. r. t. m. y. f. l. l. e. m. a. l. o. f. a. a. a. y. t. Th.  
k. k. l. l. d. g. p. s. a. e. t. h. p. t. u. t.

of kink locked gas on a bowel wall rendered anæmic from the pressure.

**CASE 2.** An emergency colon resection, the end to side of ileum to mid transverse beginning at distend 30 hours after operation. The anti-kink dressing had been so put that the abdomen was free to expand. The patient as given 4 doses of fundin-cubecinetum each at five minute intervals and passed much flatus through the rectal tube. Three grains of calomel as given by mouth at 4 acidophilus milk as started. With the last dose, finally of another dose of fundin there was a good bowel movement from the calomel and the abdomen remained soft and flat.

#### SERIOUS CASES

If symptoms persist after initial treatment with infundin, gastric lavage with small tube, colon irrigation and acidophilus milk, a fixed kink is probably present. Unequal abdominal distention, clear return from a colon irrigation or malodorous vomiting are indications for interference even though some flatus be passed. Catheter jejunostomy as a first stage should be seriously considered as the cases are poisoned and with all our modern supportive measures often resuscitate poorly after relaparotomy. It is not quite the life

saver we had hoped however as kinks in peritonitis cases may be multiple and the catheter from a limited segment of bowel Sampson Handley recommends the heroic procedure of draining the jejunum into the transverse colon by anastomosis and draining the colon by a caeco tomy. Late cases of this type are yet a little beyond our present efforts and challenge further research into the intestinal toxins which make them such bad risks for relaparotomy.

#### SUMMARY

While there may have been a transient upset of intestinal physiology kinking and not paralytic ileus is the pathology of ordinary postoperative gas pains distention and obstruction.

The occurrence of kinking can be rendered less likely by keeping down the intestinal caliber by diminishing gas production with acidophilus milk by applying loose postoperative dressings especially over the pelvis and by eliminating early the gas formed during the period of inhibition.

When interference is imperative the question of doing a catheter entero tomy previous to obstruction relieving relaparotomy should be seriously considered.

#### BIBLIOGRAPHY

1. BRACKS CLINTON and AHLEY Entero tomy its surgical importance *Surg Gynec & Obst* 19 6 viii 3 2
2. CATCH TR LER and AYERS Effect of gaseous distention on obstructed bowel *Arch Surg* 19 vi 1213
3. HUNT V C Caeco tomy for paralytic ileus following extraperitoneal operations *Surg Gynec & Obst* 19 vii 1
4. LANC J W The value of enterocolic tomy combined with entero tomy in acute peritonitis *Surg Gynec & Obst* 19 6 viii 61
5. R W L A D R I Acute intestinal obstruction *Clin J Lond* 19 3 li - 83
6. SAMPSON HANDLEY H Huntenan Lecture *Brit J Surg* January 19
7. THOMSON WALKER SIR JOHN and EVERIDGE JOHN Carson's Modern Operative Surgery London Cassell & Co 19 4 ii 536

## THE CURE OF AN INTRACTABLE VESICOVAGINAL FISTULA BY THE USE OF A PEDICLED MUSCLE FLAP

### A NEW CONCEPT

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THE earliest pages of medical history give proof of the fact that the subject of vesicovaginal fistula has always merited considerable attention on the part of surgeons. Hippocrates made mention of the fact that it was a relatively common condition and due usually to a protracted labor. From that time on while the subject received considerable discussion nothing definite regarding the possibility of obtaining a cure was brought forth until 1663 when Van Roonhuysen of Amsterdam suggested the use of sutures as a means of closing such a fistula. The next important advance was made by Jobert in the early part of the nineteenth century. He suggested and practiced the transposition of the labium of one side to be placed into the fistulous opening as a plug. Agnew in describing his method says "The circumference of the fistula being drawn down was freshened a flap was raised from the inner surface of the labium and being turned into the opening was secured by a number of stitches. A catheter was kept

constantly in the bladder during the treatment. In one case the growth of hair the follicles of which were in the flap induced a vaginitis.

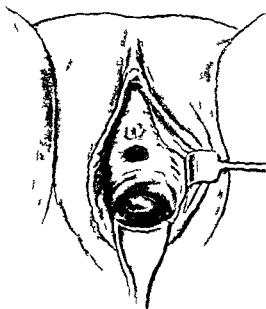
Next came the important contribution of J Marion Sims. This consisted of the following:

1. The use of a speculum which permitted of thorough exploration and ready accessibility to the fistula.

The introduction of a suture which would remain a long time without inducing either irritation or ulceration.

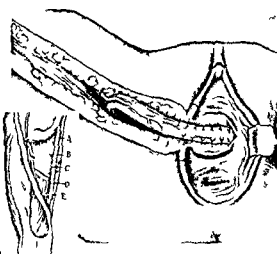
The introduction of the indwelling catheter. Following the publication of this work the incidence of cases cured by operation rose very rapidly. Numerous modifications were offered notably by Agnew. But all in the final analysis embodied the same principles. In 1873 Agnew reported 60 cases with 3 deaths and 5 failures certainly a remarkable record.

Mackenrodt in 1894 made the next notable advance. He recommended the separation of the vesical and vaginal walls from each other isolating



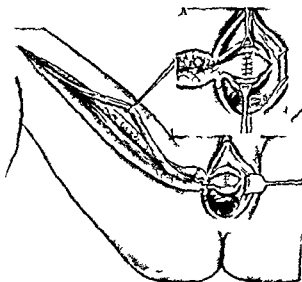
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tion and closure of the fistula and then separate  
ure of the vaginal mucosa. This was made a  
great improvement over Sims' method of inver-

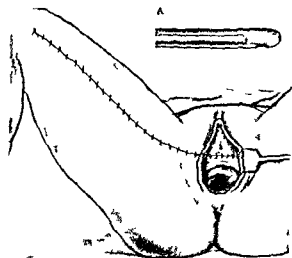


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sion suture of bladder and vaginal walls com-  
bined. The final conception of the repair process  
involved in the closure of these fistulae was reached



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when it was realized in the early part of the twentieth century, that in addition to Mckenrodt's principle it was necessary to mobilize the bladder extensively before a cure could be regularly expected.

This then brings us to the situation at the present time. Most surgeons are agreed now that the operative cure of vesicovaginal fistula is dependent upon the following factors:

1 Fashioning of vaginal flaps, the bladder wall being thus separated from the vagina.

2 Inversion of the fistulous opening by means of sutures.

3 Extensive mobilization of the bladder. In this regard Watkins' recommendation for mobilization as far as the broad ligament attachments is probably too radical and unnecessary.

4 In high fistulae the use of the incision recommended by Schuschardt whereby greater accessibility to the deeper recesses of the vagina is obtained. This step applies particularly to fistulae following hysterectomy.

5 Approximation of the vaginal flaps over the repaired bladder in such a way as to place the suture line at some distance from the suture line in the bladder wall.

6 The use of an indwelling catheter. In this connection it is interesting to note that Sturm Dorf reported in 1925 a case of fistula cured by his tracheloplastic operation following which no bladder drainage was used. Incidentally in cases in which the fistula is situated near the cervix the procedure carried out by him should merit serious consideration.

7 Careful postoperative care aimed at the prevention of cystitis.

Apparently a combination of two factors favors repair: mobilization allows the bladder to contract and thus to diminish the size of the opening at the same time lessening tension on the suture line and mobilization also favors the gliding and displacement of tissue planes one upon another so that broad raw areas come into apposition.

A study of the literature indicates that the acceptance and practice of these principles results in cure in the majority of instances. However, not uncommonly a case will not respond to this form of treatment and recurrences develop. Operations are performed again and again and still the fistula recurs. One author reports eighteen operations on one patient without obtaining a cure. Barring the presence of constitutional disease the cause for each recurrence seems to be a local one. The base of the bladder soon becomes converted into dense scar tissue of great vulnerability and the vaginal mucosa becomes markedly

atrophied. Each operative attempt at cure causes more tissue slough and a vicious circle is established. In the past heroic measures have been adopted by surgeons to afford these patients some relief from a most distressing disease. These have ranged from suprapubic cystostomy to obliteration of the vagina distal to the fistula adding thereby a vaginal pouch to the bladder and even implantation of the ureters into the rectum by the Coffey operation.

Such a case came under our care a year ago. Three well planned and well executed operations had been performed in an attempt to cure a fistula situated near the vesical neck. After each operation the fistula recurred while the patient was still in the hospital. After the last operation the fistula measured  $\frac{3}{4}$  of an inch in diameter and involved part of the urethra. The bladder was markedly contracted and its base was converted into dense scar tissue fully  $\frac{3}{8}$  of an inch in thickness. The vaginal mucosa was atrophic and lined by encrusted urinary salts. It was evident that this problem had to be approached from a different standpoint than ordinarily considered in the treatment of vesicovaginal fistula.

It was finally decided that three factors had to be considered and they proved to be of the greatest importance in effecting a cure:

1 The use of an atraumatic technique in the performance of the operation. The importance of this point has been repeatedly stressed in our work in tendon surgery. (See *Annals of Surgery*, January 1926 and January 1927.)

2 The interposition between bladder and vaginal mucosa of a layer of normal tissue of good blood supply and of known resistance to infection. In other forms of surgery such tissue has been excised in a pedunculated flap of muscle. A fascial flap was considered but was discarded because of its thinness and its susceptibility to infection.

3 The use of continuous intravesical suction carried out through a retention catheter in order to keep the bladder dry at all times.

The history of this case is reported in detail because it is felt that the operation described offers a different concept of the repair processes in the cure of intractable vesicovaginal fistula and opens up a wide field in the future development of this type of surgery.

*Case Report.* Mrs. C. B., age 44 years, American married, was admitted to the hospital in April 1927 for the repair of a recurrent vesicovaginal fistula. She had had four full term pregnancies. Each labor had been noted as being very easy. She had also had four abortion throes of which had been induced. In her past history the following important facts were determined. On October 25, 1918, a



The postoperative care of this patient was tedious and it was necessary to attend the great importance to the minutest details. It was found that the inner catheter had to be changed every 48 hours to insure continuous suction. This intravesical suction was maintained for a period of 24 days. On the fourth day after operation the patient was taken to the operating room and the vaginal packing was removed. The anterior half of the posterior vaginal flap was found to be sloughing. The muscle however was intact and apparently united to the bladder. There was no leakage. Following this the patient was dressed every other day in the operating room the treatment consisting of irrigation of the bladder with acriflavine solution prolonged vaginal douche repacking of the vagina and readjustment of the indwelling catheters. The immobilizing splint was maintained for a period of 24 days.

A superficial infection developed in the middle of the thigh wound but this soon cleared up. There was considerable edema of the lower half of the divided right vulva. This was thought to be due to a vascular change incident to its division into two parts. This edema soon subsided.

On the day that the suction apparatus was removed May 6 1927 there was no evidence of any leakage and the patient voided voluntarily about every 2 hours the quantity at each voiding measuring 2 to 4 ounces. This voluntary control continued while the patient remained in bed. She was allowed out of bed on May 6 1927. On this day it was noted that there was less control of the bladder and a little spilling occurred through the urethra. She was discharged from the hospital June 5 1927. Following her return home she developed a mild phlebitis of the right femoral vein. This subsided after about 3 weeks.

At the present time the situation is as follows: the wounds are healed. When the patient lies down she has complete control of the bladder so that upon arising she is able to void satisfactorily. When she is up and about for any length of time and becomes tired there is not infrequently a discharge of urine through the urethra. She states that at times she feels she is able to contract the tissues around the neck of the bladder and thus control the outflow of urine. This however requires considerable effort. Examination at the present time shows the following: the thigh wound is firmly healed and there is no impairment of motion as a result of the transplantation of the gracilis muscle. The right half of the vulva is slightly deformed. The urethral orifice is somewhat patulous and easily admits a

No 20 F catheter. In the recumbent position there is no leakage of urine. Stretching across the base of the bladder is felt a ridge of soft tissue measuring about 2 inches in its anteroposterior diameter and extending from the right to the left side of the base of the bladder. The vaginal mucosa is smooth and glistening. The patient feels that she has been considerably improved by the operative procedure.

It is felt that the limit of improvement as regards voluntary control has not as yet been reached.

#### SUMMARY

A case is reported of the cure of a large urethrovesicovaginal fistula by the utilization of a pedunculated muscle flap taken from the inner side of a thigh in the form of the gracilis muscle. In addition use was made of continued intravesical suction extending over a period of 24 days without any evidence of vesical infection. It is felt that the findings presented constitute a new and additional concept in the management of cases of intractable vesicovaginal fistula.

#### BIBLIOGRAPHY

- ADEODATO J. A proposito das fistulas vesicovaginaes. Rio de Janeiro Brazil Medico 1919 p 11.  
 AGNEW DAVID H. Lacerations of Female Perineum and Vesicovaginal Fistula. Their History and Treatment Philadelphia Lindsay and Blakiston 1873.  
 ANDERSON J. C. Vesicovaginal fistula. Med Herald 1901 April.  
 BAKER WM H. Unusual cases of vesicovaginal and vesico uterine fistula. Boston M & S J 1885 Feb 26.  
 BERNAYS AUGUSTUS CHAS. Operation of vesicovaginal fistula: a comparison of the methods of operation of N. Bozeman N. Y. and Professor Gustav Simon Heidelberg Louisville Ky 1877 11.  
 BISHOP. Lancet London 1897 i 165.  
 BOZEMAN NATHAN. Operation of Vesicovaginal Fistula without Aid of Assistants with a View of Relative Merits of Clamp Interrupted Silver and Button Sutures. New York D. Appleton & Co 1869.  
 Idem. Urethrovaginal and Vesicovaginal Fistulae: Remarks on their peculiarities and Complications. Their Classification and Treatment. Modifications of Button Suture report of cases. Montgomery Barrett & Wimbish 1857.  
 Idem. Urethrovaginal vesicovaginal and rectovaginal fistulae: general remarks report of cases treated with button suture in this country and in London. Edinburgh Glasgow and Parisian Hospitals. New Orleans 1860.  
 Idem. Vesicovaginal fistulae: comparative analysis of different surgical methods. Am J M Sc 1870 July.  
 BRACQUEHAYE. XIII Congrès Chirurgie 1899.  
 BRICKNER SAM M. Vesicovaginal fistula following abortion in an operated case of incomplete congenital transverse septum of vagina. New York M J 1909 Jan 23.  
 BROWN ISAAC B. On vesicovaginal fistula and its successful treatment. London Savill & Edwards 1858.  
 BUSCH WALDEMAR. Zwanzig Blasenscheidenfisteln. Jena A. Neuenhahn 1874.  
 BUZZI ROBERTO. De la voie transperitonéo vésicale. Paris Jouve & Cie 1923.

# SUPGERY GYNICOLOGY AND OBSTETRICS

- CHABOY RENÉ Tr it m nt de fistul s ovag als  
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- CIELIUS M Jos von U ber de he lu g d bl s n  
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- CHILD CH S G JR P tope t t tm t of c co  
agnal fistulae Am J Ob 1917 l 1 No 3
- COEUR L L D s pr c d de d boub m t dans le  
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- CORTING B L V i g al fist la Sponta cous relif  
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- DAVALO A J De la o e u pub nn t ésciale da  
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- JUDD L S Operat r tm t of o ag n l fistul s  
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- JUREVO R FRIT U b e d h ru g s h B hndl g d r  
Bla nm t n u l Bla hed f t l Fr kf  
S c i t t dru k 19 5
- KELLY Op ati Gynec logy l 1  
Idem Bull J h s Hopk H sp 1899 x 115  
Ib d 1901 xi
- Idem T Am Gy c Soc 1906
- KOLISCER A d JONES A contrib n t the per tu  
te h que in co g n l fistula Urol & C ta R  
St Louis 19 5 1 593
- KOLLOCK P M Hist ry nd T e tme t of Ve i ovagual  
F t la a R port A gu ta J M r 857
- LINDENMAYER MAX Ueb r Entst h ng u d H il ng d r  
Blasensche denfistel 849
- M KENRODT Zentralbl t t f Gynaek 894 No 8 8
- MAIRE J Contrib tion a l l t d d Fistul V é o  
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f r 926
- MARCY HENRY O Ves vag n l fist l and recto ag al  
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- Idem C e of ves g n l fist l by fre d ect f  
bladder from its vagi al t t chm t s d clous e with  
b ied cont auo s t e do utu e J Am M Ass 897  
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- MAJO AND WALTERS Operati e tr tm nt f s i gi  
n l fistulae S rg Cl North Am r a 19 4 iv 399
- MAZE JULES Del Méth d d Ded blem nt d n le  
T a t m nt Ch ru g i al d s f t l V é s co vag n l  
P r n 902
- MUSSEY Wn H V co ag n al fistula W st Lan t  
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- NOBLE C A S P Cl e of o v ag n al fistula f llow  
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ed es by vag al t Am Gyn c & Ob t J  
1898 Nov
- ROEDER C A Tech q fo rep r fl ge o g l  
fistula Surg Gyn & Ob t 1927 l 1 14
- SCHUPPERT MORIT A t eat on v e c vag l f t la  
N w O le z s Comm c l Bull tin Pri t 1866
- SCHUSCHARD A ch f Gyna k 1888 No 47
- SIMON D tutch Klau 968 Nos 45 d 46
- SMB J M Am J M Sc 85 x 11 59
- SUTTH L Phil delph M J 1902 Feb 5
- STURMDORF P ma nt o clu o n t et b  
vesicov g n al fist l by t ch l pla t flap S g  
Gyn & Ob t 1925 l 3 8
- TE VIST U ARTHUR Delaf t u l e vé ag n ale St a  
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- TRENDLENBURG F Zur operation d Bl n ch d  
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## RESECTION OF THE CÆCUM AND ASCENDING COLON

HOW THE MORTALITY MAY BE REDUCED BY MODIFICATION OF THE USUAL OPERATION<sup>1</sup>

BY ARTHUR A. SALVIN, M.D., NEW YORK

A c t i d g s g Syd h m H p t l

**E**XCLUSIVE of the rectum the parts of the colon most frequently involved in malignant disease are the two most mobile portions namely the cæcum and the sigmoid. In a large series of cases studied by Judd (3) the incidence was as follows: cæcum and ascending colon 159, hepatic flexure 29, splenic flexure 24, descending colon 46, transverse colon 75, and sigmoid flexure 292. Thus in 5 per cent either the cæcum or ascending colon was involved.

Nearly all authorities are agreed that the proper treatment in operable cases of carcinoma originating in the cæcum or lower portion of the ascending colon is resection of the entire ileocaecal coil of intestine as high as the distribution of the middle colic artery accompanied by an anastomosis between the ileum and the transverse colon or some other short circuiting operation. Without surgical intervention cancer of the cæcum inevitably gives rise to early intestinal obstruction. Although attended with a high mortality resection of the cæcum prolongs life and the patient may pass his last days in relative comfort.

Charles Mayo and Hendricks (5) report that of 257 patients with carcinoma of the right segment of the colon subjected to operation during a 10-year period 141 are known to be dead, 34 cannot be traced, 55 lived from 1 to 4 years, 25 lived from 6 to 8 years, and 12 are alive from 8 to 9 years after operation.

Considering the gravity of the disease for which the operation is performed we find the end results of resection of the cæcum and ascending colon comparatively good except for the high immediate mortality which is said to vary from 15 to 45 per cent. The situation has been well stated by Judd (4) of the Mayo Clinic as follows: The immediate results from operating for cancer of the colon have been rather unsatisfactory and the mortality is altogether too high. On the other hand the ultimate results in patients surviving operation have been very satisfactory as compared with operation for cancer in other regions so that if we can develop some standard technique for the operation of cancer of the colon the ultimate results will be very successful. There are several types of operation. The ideal operation is resection in one stage with anastomosis.

Aside from malignant disease the most important indications for ileocaecal resection are tuberculosis of the cæcum and chronic ileocolic intussusception.

## MEASURES ADVISED TO LOWER MORTALITY

Crile (2) has employed the following technique in an attempt to lower the mortality from resection of portions of the colon. A two stage operation is preferred and the fecal stream is short circuited to exclude the field of operation. An iodoform gauze pack is used to prevent contamination of raw surfaces and protect the retroperitoneal space against infection. Crile resorts to wide resection to prevent recurrence and employs radium and deep roentgen ray therapy.

Rankin (6) advises resection of the ascending colon and end to end anastomosis with a Murphy button. Two points of suspension are selected, one at the head of the cæcum the other at the point on the transverse colon where the ileum is to be anastomosed. In freeing the cæcum one should not attempt a digging operation. While mobilizing the upper angle of the ascending colon the operator must be careful to avoid injury to the retroperitoneal duodenum. Rankin restores the continuity of the intestinal lumen by open end to end anastomosis between the ileum and the colon or by end to side anastomosis. He prefers the former technique and uses two layers of tannic acid catgut in the anastomosis. The first suture unites the mucous coats of the bowel the second layer the serosa. After the mucous stitch has been put in the lumen of the bowel is held open by blind introduction of the thumb and forefinger.

When complete cancerous obstruction of the colon is allowed to develop the patient necessarily suffers severe toxæmia and is rarely able to survive an extensive operation. Even without complete obstruction infection is the most important cause of the mortality from the customary operation of resection of the ascending colon and intestinal anastomosis. If the suturing should be imperfect or there should happen to be a poorly anastomosing circulation in the sutured ends of the intestine intestinal leakage is very likely to occur and cause peritonitis.



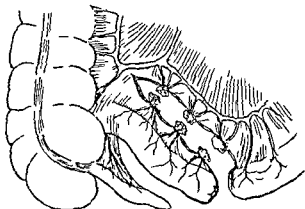


Fig. The ileum is retracted by the upper part of the abdominal wall to the right of the midline.

The shock of operation too is necessarily considerable. Should the anesthetist report danger during the resection of the cæcum the surgeon must nevertheless continue the operation at least to the extent of performing an intestinal anastomosis. To be sure should the condition be very alarming he may order the anesthesia stopped and leave an ileal fistula. But ileal fistula produces such unfavorable effects that it should be avoided whenever possible. It would seem desirable therefore to modify the usual operation to the extent of removing the danger of fecal contamination and devising an operation that may be interrupted if necessary at any time.

#### ADVANTAGES OF REVERSED OPERATIVE STEPS

By a simple expedient I believe that I have been able to eliminate the most objectionable features conducive to the high mortality from resection of the cæcum that is by reversing the usual procedure and first performing intestinal anastomosis and then excision of the diseased colon. A one stage operation is still used although it may immediately be converted into a two stage procedure should occasion demand.

What are the advantages of the reversed procedure with regard to the danger of infection? The colon is a heavily contaminated area. As soon as it is opened the danger becomes great. With perfect technique it is possible to effect a completely aseptic anastomosis between the ileum and the transverse colon but the extensive manipulation and excision required in connection with the mobilization and resection of the cæcum are bound to result in more or less leakage. Especially is this the case when the intestinal current has not already been short circuited for peristalsis is not completely inhibited even when

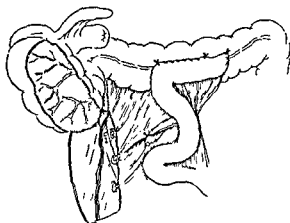


Fig. Up completion of the ileal anastomosis. The ileum is then brought down to the cecum and secured by a suture.

the intestines are exposed and the fecal contents tend to exercise some degree of pressure against clamps and sutures of the area to be resected.

If the anastomosis has already been established the natural current of the fecal matter toward the sigmoid flexure is not molested therefore the pressure against the area being resected is appreciably lessened and the degree of contamination is thus definitely diminished.

Another important fact is that when the procedure that I advocate is followed such contamination as takes place from resection of the cæcum occurs at the close of the operation whereas when the usual method is adhered to infection is more likely to occur early in the operation. While the delicate work required for the anastomosis between the ileum and the transverse colon is being done there is no breach of asepsis. Such contamination as necessarily results from extensive resections of the cæcum may be handled adequately by suitable drainage. In the great majority of cases no drainage is required. It is only when asepsis has been imperfect or the retroperitoneal space cannot be closed that I consider this precaution necessary.

A theoretical advantage of some importance is the fact that the fecal current is not interrupted during the course of the operation for when the cæcum is clamped off preparatory to its resection a short circuit of the fecal stream has already been established. When the cæcum is excised first a temporary artificial intestinal obstruction is produced from the moment when the clamps are first applied to the segment to be removed and it lasts until the anastomosis is completed. There is good reason to believe that such

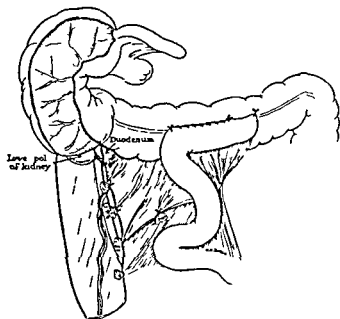


Fig 3 Separation of colon to hepatic flexure

temporary intestinal obstruction results in a certain measure of toxæmia for it has been fully established by experiments on dogs that following the artificial induction of intestinal obstruction definite chemical changes in the blood appear within a relatively short time. It would seem of advantage therefore to utilize a procedure that avoids even a temporary intestinal obstruction.

Once the intestinal anastomosis has been established the operation may be discontinued at any time whereas when the cæcum is resected first it is necessary to complete the anastomosis. Should the patient's condition become unfavorable during the resection of the cæcum in the reversed procedure that I am advocating operation may be discontinued at once. If the cæcum has already been mobilized and the resection is well under way it may be left outside the abdominal wound to be removed at such time as the patient's condition permits.

#### TECHNIQUE

In performing anastomosis of the ileum to the transverse colon followed by resection of the cæcum I have largely followed the technique described by Victor Schmieden (1) in *Chirurgische Operationslehre* pages 356 to 363. My results have been so favorable as to impress me with the superiority of this procedure over the method customarily practiced.

The type of ileocecal resection here described is applicable to the treatment of neoplasms in tussusception and tuberculosis of the cæcum.

A long pararectal incision is made on the right side to expose the site of operation. It may be

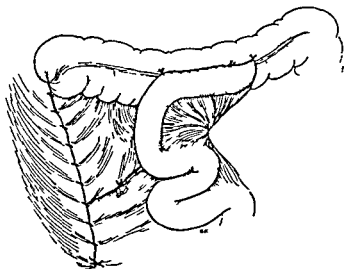


Fig 4 After the removal of the ascending colon and closure of the transverse colon the intra-abdominal operation is finished by closing the defect in the posterior peritoneum

prolonged upward or downward according to indications. A small incision is not desirable as it may prolong the operation and increase the difficulties. When the tumor is exposed the patient is placed in a moderate Trendelenburg position with the right side a little higher to keep loops of small intestine away from operating field.

The intestinal anastomosis should be effected before beginning resection of the cæcum. Two firm ligatures are placed at a point about 6 to 8 inches (15 to 20 centimeters) above the ileocecal valve and the intestine is sectioned between them with the thermocautery or phenolized scalpel. The two cut ends are then folded in and sutured or secured by a purse string suture and the pads changed. Step by step between two ligatures the mesentery of the small intestine is separated from the part of the intestine still united with the cæcum. The direction of this mesenteric separation depends on the degree of involvement of the mesenteric lymph glands.

The next step is the implantation of the proximal end of the ileum into the transverse colon. This is accomplished by a lateral isoperistaltic apposition through the tænia coli and a wide anastomosis. Many operators employ the Murphy button for this purpose. Being easily accessible through the incision the middle of the transverse colon is used. The anastomosis is then replaced into the abdominal cavity which is well filled with new pads.

The cæcum is resected as follows. It is drawn toward the median line and the outer fold of the peritoneum is cut away from its lateral and lower borders. No important blood vessels are en-

countered in this procedure. The cæcum is then brought further from its source toward the median line so that its posterior extraperitoneal portion becomes visible. Then the right ureter is exposed as it turns downward over the psoas major muscle. In this way it may be protected from injury. The intestine now hangs on the median fold of its mesentery which contains the large blood vessels passing to the ileocecal region.

The next step is gradual separation between ligatures of the inner fold of the mesentery while the cæcum is being lifted upward. How much of the mesentery must be taken with the cæcum depends on the degree of involvement of the lymph glands. Enlarged glands are most likely to be found at the points of origin of the ileocolic and right colic branches of the superior mesenteric artery. A large portion of the posterior abdominal wall must be denuded of peritoneum. When the ascending colon is detached upward the lower portion of the duodenum is encountered. It must be carefully protected from injury. To one side of this retroperitoneal loop of duodenum lies the right kidney. The mesentery is detached and ligatured and the ascending colon drawn forward up to the healthy portion. The central ligatures must be very carefully placed as any break would result in severe hemorrhage. The first ligature in the mesentery is placed close to the intestine. The cæcum itself has no mesentery.

The closure of the end of the large intestine does not differ in principle from that of the small intestine but it is more difficult as such intestinal stumps are easily perforated. A preliminary closure is made with ligatures according to Graser's method. Then two or more infolding sutures are made according to Lembert's method and the appendices epiploicæ are sutured over them or the stump may be protected with omentum. It is important to cover a portion of the intestine behind the stump with peritoneum so that the suture may join surfaces covered with serous membrane. Then the stump is repeatedly infolded until the closed end is near the posterior abdominal wall. With this method of closure the intestine can usually be returned to the abdominal cavity but a drain may be placed near it as a precaution. Usually no drain is required. It should be used only when the surgeon is not sure of his asepsis and there has been difficulty in closing the retroperitoneal space. Schmieden opposes suturing the stump in the abdominal incision as this procedure is apt to interfere with the circulation or stretch the mesentery.

Although extensive this operation may be performed with very little loss of blood except

in the case of widespread lesions. It has the advantage of avoiding the necessity of leaving an ileal fistula should the patient's condition become alarming at any time since the intestinal anastomosis is completed before the resection of the cæcum is begun.

If there are numerous adhesions the difficulties of the operation are increased. In such cases it may be advisable to perform a two-stage operation. If the second stage of the operation is to be performed a few days later the abdominal wound may be left open for the most part and the portion to be resected shut off from the rest of the abdominal cavity by tamponade. After the involved portion of intestine is shut off so that fecal matter does not pass through it the wound may be closed so as to leave a fistula of only this portion. Then resection may be done several weeks later. In such cases not only the cæcum but also the hepatic flexure should be excluded. In some cases complete resection is impossible and the ileocecal region can only be excluded from the rest of the intestine and radical operation not done.

#### CONCLUSIONS

1. Resection of the cæcum and part of the ascending colon is usually indicated for malignant disease in this locality, also for tuberculosis of the cæcum and chronic ileocolic intussusception. In malignant disease it relieves intestinal obstruction, prolongs life and greatly lessens the patient's discomfort.

2. Although the end results of ileocecal resection are good there is a high operative mortality following the usual operation.

3. Infection from fecal contamination, surgical shock and toxæmia from temporary intestinal obstruction play a large part in causing the high mortality from ileocecal resection.

4. By reversing the usual procedure and performing the ileocolic anastomosis before excising the cæcum we may greatly reduce the mortality. Should the patient's condition become alarming during the course of the operation the latter may be discontinued at once. Furthermore the danger of infection and toxæmia from temporary intestinal obstruction is greatly diminished.

#### REFERENCES

- BIER, A. BRAU, H. and KU. *ELL H. Churgsch*  
Op. on the 03 1356 303  
C. ALLE, G. W. Oh. St. M. J. 93  
3. JUDD, E. S. So. th. M. J. 194 75  
4. Id. m. Ab. t. ct. fd. cu. n. cl. by R. k.  
5. M. I. C. H. D. HENDRIC S. W. A. An. S. g.  
061 357  
6. RANKIN, F. W. J. Am. M. Ass. 94 1277 86

# EDITORIALS

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## SURGERY, GYNECOLOGY AND OBSTETRICS

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AUGUST 1928

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### CO OPERATION OF SURGEON AND PEDIATRICIAN

ONE factor in the recent progress of surgery has been the co operation of the internist and surgeon in the pre operative preparation and postoperative care of the patient. Co operation of pediatrician and surgeon is even more essential because few surgeons are well versed in the care of children particularly infants. To meet this situation a number of children's hospitals have been so organized that all children are admitted to the medical service and the surgeon acts as a consultant as do the otolaryngologist, ophthalmologist and other specialists. This mode of hospitalization aims to secure proper attention to the nutrition and general health of the child.

Every child who is to undergo a surgical operation necessitating general anesthesia should have a general physical examination within the 24 hours preceding operation in order to rule out the presence of acute infection especially of the upper respiratory tract as well as any of the infectious diseases and also to be sure that the nutritional condition is such that healing will proceed normally

after operation. One of the most glaring mistakes is to admit patients to hospitals for tonsillectomy on the morning of the operation sending them directly to the operating room without previous examination and without even having the temperature taken. It is therefore not surprising that postoperative complications and even sudden death occur so frequently.

Next to circumcision the operation most frequently performed on very young patients is for hare lip and cleft palate. This group of patients presents a definite nutritional problem for many are markedly undernourished because the deformity has prevented them from nursing at the breast or has made the taking of food difficult. For a surgeon to operate on a patient who is several pounds underweight is to invite not only operative failure but possibly the death of the patient. Feeding by gavage for a period sufficiently long to bring these children up to practically normal weight will insure freedom from marked febrile reactions, bring about prompt complete healing and reduce mortality to practically nil.

The co operation of surgeon and pediatrician is particularly necessary in the care of patients with pyloric stenosis. Many patients recover by medical treatment alone but a certain group requires surgical attention. Operation is sometimes delayed in these cases until the surgical risk is unnecessarily increased. A bad surgical risk may, in 24 hours be transformed into a fairly good surgical risk by means of blood transfusion, proper intravenous injection of glucose and physiological sodium chloride solution by hypodermoclysis. The

# MASTER SURGEONS OF AMERICA

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## THEODORE FRELINGHUYSEN PREWITT

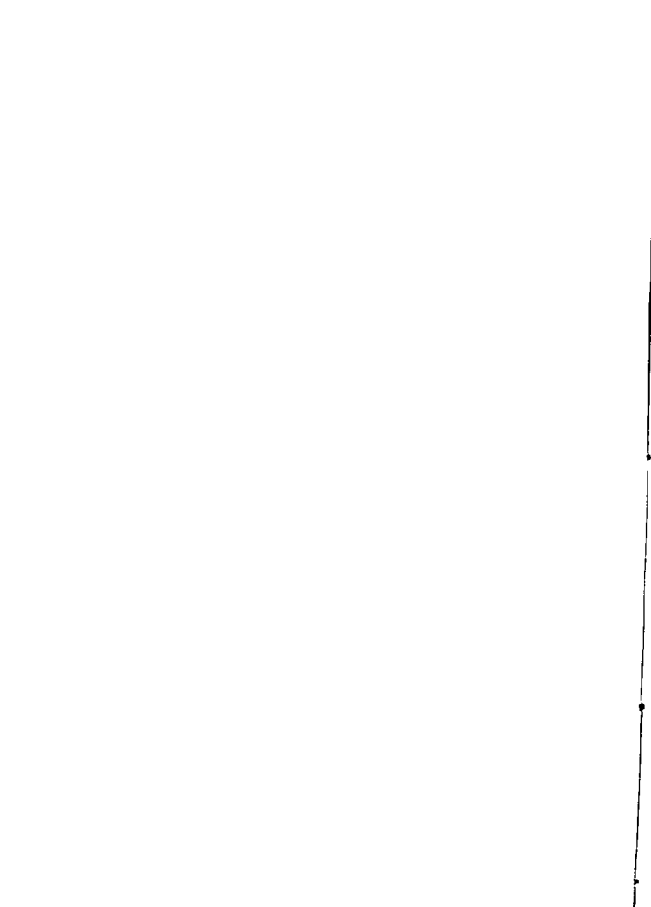
THL E are many men whose teachings beneficent influence and good example are carried along indefinitely through succeeding generations without proper credit being given to him who deserves it. So it might be with the name of Theodore F. Prewitt. His writings would make a considerable number of large volume if they were compiled in such form. He wrote no textbooks but his teachings will undoubtedly bear fruit for many years because his pupils and assistants are widely distributed throughout this midwestern territory. They are practicing and teaching and so are disseminating that knowledge which they have learned from their chief and master.

Theodore Prewitt was the son of Joel and Mary Trimble Prewitt. He was born in rural Missouri at Fayette in Howard County on March 1, 1832. By the death of his father, who left a family of eleven children, this schoolboy was thrown upon his own resources at the early age of 14. It is said that he was employed for a time as a blacksmith's helper. This may explain the reason for the tremendous development of the muscles of his arms and shoulders which gave him the ability to exert that great amount of force which, in addition to his acquired skill, attracted attention whenever he reduced fractures and dislocations, some of which had defied the attempts of others to reduce them. By perseverance and industrious application he acquired as good an education as was possible to obtain at a Missouri country side and this enabled him to teach school for a number of years. He entered St. Louis Medical College and graduated in 1856. He married Miss Mary Ingram of Virginia during the senior year of his medical course and at once began the practice of medicine at Utica, Missouri.

Upon the death of his wife in 1862 he came to St. Louis, entered into practice and soon became identified with medical education, teaching dermatology at the original St. Louis College of Physicians and Surgeons. Later he became demonstrator in anatomy and assistant to the chair of surgery at the Missouri Medical College. In 1871 he was married to Miss Mary Sowers, who still survives, and in that year he was appointed superintendent of the St. Louis City Hospital. Three years later he resigned this position to continue his surgical



THEODORE G PREWITT  
183 -1904



studies at the European medical centers. Upon his return from abroad he accepted the chair of principles and practice of surgery at the Missouri Medical College and later was for several years dean of this institution. After the consolidation with the St. Louis Medical College in 1890 to form the Medical School of Washington University he continued in this same professorship. Only when his advancing age and failing health prevented it during the last 2 years of his life did he fail to lecture regularly. This disability was due to arteriosclerosis and several light strokes of apoplexy. He recovered fairly well from the resulting hemiplegia but finally succumbed to a severe cerebral hemorrhage on October 17, 1904.

For a quarter of a century he was chief surgeon to St. John's Hospital and director of St. John's Surgical Clinic. It was here that his most important work was accomplished and that material gathered which he presented at his frequent appearances before medical and surgical societies, the meetings of which he attended with great regularity.

Besides other offices held by him at various times he was president of the following organizations: St. Louis Medical Society (1876), Missouri State Medical Association (1897), St. Louis Surgical Society, American Surgical Association (1900) and the St. Louis Obstetrical Society. He was also a Fellow of the American Medical Association and of the Philadelphia Academy of Surgery.

'Be not the first by whom the new is tried

Nor yet the last to cast the old aside

This rule he frequently quoted and always kept in mind. Thus he made himself exceptionally useful in the application of accepted methods. But this motto did not lessen his eagerness to learn the latest innovations and he never hesitated to apply any procedure which seemed practical in the light of scientific reasoning. Living and working as he did in a period of great progress in medicine and surgery he saw these developments at close range and utilized the new discoveries as promptly as their worth was recognized.

When in the year 1893 the daily press announced the discovery of the X-rays by Professor Roentgen, Dr. Prewitt immediately appreciated their great value in the field of surgery. With the intention of using these rays in his practice he forthwith consulted Prof. Charles O. Curtman and several others who were familiar with induction coils and Crookes tubes. The apparatus of that day was too small and weak to give practical results. So he could not apply this new discovery as soon as he wanted it. The matter was dropped for a short time only to be taken up again when a more powerful coil and larger tubes had been invented and manufactured. During this period Dr. Prewitt manifested an extraordinary spirit of impatience and anxiety which he never entirely lost. He left this world before the X-rays could be properly controlled and their application established as a distinct branch of medical practice.



I am able to give only a vague idea of his clear and logical reasoning which was usually followed by definite and positive conclusions nor can the proper comprehension of the remarkable diagnostic genius of this man be drawn from any account that I might picture to those who did not at some time or other have the privilege of daily contact with him. In those pre X ray days he astounded those associated with him when he recognized by exclusion of other possibilities a small osteosarcoma which grew from the glenoid process of the scapula and when he proved his contention by a subsequent surgical procedure.

At another time he made a diagnosis of ectopic pregnancy twice in the same fallopian tube. This was long before blood cell counts were a daily routine. At its first occurrence he strongly urged operation. The woman persistently refused but recovered after a fairly long period of illness. A few years later he found the same condition in the same fallopian tube. This time he was again certain, obtained her consent by pleading with the patient and verified his diagnosis at operation. The specimen showed the recent rent with the usual extravasation of blood and also the cicatrized site of the earlier rupture in that same tube. May these two illustrations suffice to show the extraordinary diagnostic ability which came only from many years of study and observation coupled with an innate fitness for this work! Such a combination is seldom found.

His resourcefulness was another outstanding and characteristic trait. I will narrate but one occurrence to illustrate this. A woman had suffered great loss of blood at an uncompleted abdominal operation attempted by another surgeon. She was nearly exanguinated. Blood transfusion was not done in those days. Not even the apparatus for infusion of salt solution was at hand. With a Davidson bulb syringe (the forerunner and predecessor of the fountain syringe) Dr. Prewitt pumped enough sterile normal saline solution into the woman's veins so that she recovered. A small nozzle had been scraped to make it still smaller so that it could be introduced into the opened vein. This patient was later successfully operated on for the then existing uterine fibroid.

Probably the only semblance of a hobby was his fondness for the works of William Shakespeare. He must have devoted considerable time to this study because he quoted from them whenever occasion offered the opportunity. It has been said that he was able to continue almost any quotation begun by others.

Professor Prewitt's most brilliant work was done in the clinical amphitheatre which institution is now fast becoming extinct. There he repeated to the students those methods of diagnosis of which he was master and which endeared him so with the large classes of medical students of that day. While other surgeons of his time were satisfied with a simple amputation of the breast for carcinoma, he dissected out the axillary and subclavian gland. Thus he anticipated the radical operation as it was developed afterward. His percentage of

permanent cures was correspondingly greater than that of his less radical contemporaries

Brilliantly daring were his dissections of the neck for tuberculous glands or malignant disease and plastic surgery had a particular attraction for him. In all of his operations he showed a disregard for speed and spectacular show. His aim was toward thoroughness and ultimate results.

The published writings of this great teacher are many and varied. They cover a large part of the field of general surgery and sometimes they invade the other branches of medicine. But they give only fair idea of his great courage and determination which were always evident to those who had the advantage of being associated with him in his work.

It can be readily imagined that such a man would soon feel the need of a medical library and therefore he started the movement to organize a medical library in connection with the St. Louis Medical Society and headed a committee appointed for that purpose as early as July 1, 1865. They reported on September 30 of that year and the adoption of this report established the first public medical library west of the Mississippi River. It was housed for a long period of time in the Public Library but later formed the nucleus of that great collection which now is again known as the Library of the St. Louis Medical Society. If any St. Louisian has contributed more to the advancement of medicine and surgery in the city of St. Louis than did Professor Prewitt, the records fail to reveal it. For over 40 years he continually served the profession and the public with all his energy. Not even when his carriage drawn by the team of roan horses took him on his rounds did he rest his ever active mind. There were always several books and periodicals on the seat beside him in this vehicle. He read the newer literature but did not neglect the textbooks with which he constantly refreshed his memory. Never was he unprepared when he entered the lecture room.

The surgery of today is not the surgery of the past generation. Laboratory methods and newer developments of many kinds have brought about an unprecedented progress. However it is to be regretted that there is throughout it all an evident neglect of that patient bedside study and wide range of medical knowledge which broadened the viewpoint and produced those masters whose memory is so dear to us. Any list of these pioneers will be incomplete without the name of T. F. Prewitt.

ROBERT I. SCHLUETER

# CORRESPONDENCE

## THE DELIVERY OF THE ADHERENT PLACENTA BY THE MOJON GABASTON METHOD

*T H Editor*—As a surgeon I have no experience of cases of adherent placenta but the technique described by Dr Julius Jarcho in *SURGERY GYNECOLOGY AND OBSTETRICS* of February, 1928 of injecting saline solution into the vein of the umbilical cord by means of a cord syringe appears to me capable of improvement. In the *Practitioner* of October, 1918 I described a method of intravenous injection of fluids which I have used repeatedly for 30 years.

Briefly this method consists in the use of a blunt bulbous ended cannula attached by a length of rubber tubing to an ordinary Higginson enema syringe the cannula being tied into the vein. The method is simple gives the operator absolute control of the amount and rate of injection and appears to be admirably suited to cases such as those described by Dr Jarcho.

C HAMILTON WHELFORD M.D. F.R.C.P.  
LONDON S. H. P. M. H. I. M. T. Y.

LIMMOUTH LANCIA D.

## LIGATION OF THE ANGULAR VEIN AS A PREVENTIVE MEASURE IN FACIAL CARBUNCLE

*To the Editor*—Hamilton Bailey in his article "Ligation of the Angular Vein as a Preventive Measure in Facial Carbuncle" in the April 1928 number of *SURGERY GYNECOLOGY AND OBSTETRICS* states:

To forestall the spread of infection by this route (angular vein) ligation of the angular vein must be a sound proposition.

Ligation of the angular vein under local anaesthesia is a measure which is entirely free from danger and usually is a very good.

If in addition to this sign (suffusion of the eyelids) there is considerable elevation of temperature the call for action is imperative.

It can not be conceded that ligation of the angular vein must be safe and that it is not fraught with danger if done under local anaesthesia. There must be much trauma in working around the angular vein under local anaesthesia especially if there is a great deal of periorbital oedema. We have all learned from sad experience that trauma of any kind helps the spread of infection through superficial lymphatics especially around the face. It has become almost a axiom not to use a local anaesthetic in spreading infections on the face for this offers a singular opportunity for further adhesion. It is exceedingly difficult to say when the angular

vein has become invaded. Clinically we see patients with the picture presented by Dr Bailey: suffusion of the eyelids and high temperature who have negative blood cultures repeatedly and who under conservative therapy get well without complications. In a recent communication in which X-ray therapy surgery conservative treatment and circuminjection of autogenous blood in carbuncles were evaluated I think that it was shown pretty conclusively how difficult it is to draw conclusions from any one type of therapy in carbuncles in which accessory therapeutic methods were also employed. These immediately introduced variable factors on one side of the equation. It was further shown how for instance one of these variable factors (conservative therapy) produced cure alone. Dr Bailey reports only three cases. In Case 1 death occurred despite the ligation of the angular vein. In Case 2 there is no proof of a blood infection or involvement of the angular vein. Yet ligation of the angular vein is given the credit for the cure when accessory therapeutic measures (intravenous mercurochrome, hot magnesium sulphate fomentations) were also used. In Case 3 the patient who had a positive staphylococcus blood culture had ligation of the angular vein and the injection of whole blood around the periphery of the carbuncle with local applications of hot fomentations and intravenous administration of mercurochrome. The patient recovered. How then can the result be attributed to ligation of the angular vein when there was so much additional therapy which in itself repeatedly produces cure?

This communication is not meant to decry the use of ligation of the angular vein selected cases of carbuncle of the face but rather to warn against the use of local anaesthesia for the procedure and to be guarded in drawing conclusions as to its real value. Rectal is far preferable to local anaesthesia. Much could be done to prevent fatalities in carbuncle of the face if the public could be educated not to prick or squeeze them and if the profession could be further impressed as it has been repeatedly before not to tamateze them with instruments.

LOUIS CARP M.D. F.A.C.S.

NEW YORK, N.Y.

## ABDOMINAL FRIGIDUS IN PERFORATION

*T H Editor*—Recently I noted in a patient with a perforated duodenum ulcer symptom which I

Carp, L., T. m. f. b. l. mpa. wa. ff. differ.  
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had never seen before and have never read of. This patient had been sent into the hospital from about 15 miles in the country. He was a man 37 years old whose past history was negative except for some indefinite indigestion several years before. About 6 hours before I saw him he had suddenly developed terrific pain in the abdomen just to the right of the umbilicus and had sent for his family physician who had been obliged to give him three hypodermic injections of one quarter grain of morphine each. The pain had not been associated with vomiting or urinary disturbance.

When seen by me he was quite comfortable. His temperature was 98 degrees, pulse 80 and respiration 24. Leucocyte count was 16,300 with 90 per cent polymorphonuclear neutrophils. Urinalysis was negative except for a faint trace of albumin and an occasional hyaline and granular cast. His abdomen was somewhat tender and slightly resistant all over. There was no localized tenderness or rigidity at any point. However when the hand was placed on the right upper quadrant a coarse fremitus could be felt—similar to the vocal fremitus felt over the thorax—but coarser and stronger. This was independent of breathing, talking or moving. It gradually became weaker and finally disappeared as the palpating hand was moved away from the right upper quadrant.

I believed that this fremitus could only be due to fluid or gas escaping from a hollow viscus and made a diagnosis of perforated peptic ulcer and urged immediate operation although the patient did not appear very sick and other than the fremitus there was very little to substantiate the diagnosis. The large amount of morphine which the patient had received was undoubtedly masking his symptoms.

At operation a large duodenal ulcer with a very small perforation was found. As gas and fluid

sputured through the perforation the surrounding tissues were made to vibrate and this was responsible for the fremitus which had been present before operation.

While abdominal fremitus in cases of perforation of hollow viscera must be rare if looked for it would probably prove to be present more frequently than might be expected. When present it would be pathognomonic of perforation and would prove most valuable in cases similar to mine whose other symptoms have been obscured by large doses of morphine.

JOHN H. LYONS, M.D.

WASHINGTON, D. C.

# AN UNUSUAL FATAL OPERATIVE WOUND INFECTION YIELDING A PATHOGENIC ANAEROBIC OF THE GAS GANGRENE GROUP WITH DIRECT REFERENCE TO CATGUT AS A SOURCE

*To the Editor*—Since the publication of our paper in the December 1927 number of *SURGICAL GYNECOLOGY AND OBSTETRICS* describing what we thought to be a new pathogenic anaerobe we have found that Dr. A. Sordelli in Buenos Aires previously described an organism in 1922 similar to ours. Hall in the November 1927 number of *Journal of Infectious Diseases* suggested that these organisms might be similar. We obtained Sordelli's strains from Hall and have determined by reciprocal serological tests that they are the same. We yield therefore to Dr. Sordelli the priority of discovery and acknowledge bacillus Sordelli and *C. oedematoides* to be one and the same species.

FRANK L. MELENFY, M.D.

FREDRICK B. HUMPHREYS, M.D.

LOUIS CARP, M.D.

NEW YORK

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# THE SURGEON'S LIBRARY

## OLD MASTERPIECES IN SURGERY

B ALFRED BROWN MD FACS OM FA

### THE MEDICO SURGICAL OBSERVATIONS OF JOHANN MECKEN

THE sixteenth century has produced the standard of anatomy as a science and thus furnish a basis upon which the practice of surgery was to be founded. Consequently anatomy had withdrawn a little from surgery so far as publication by the physician concerned. It is difficult that part of his science to the student of surgery to carry it on especially as far as his contemporaries had raised the surgery to a position of prominence. The profession both as a consultant and operator. Translations of the anatomical works of the ancients had been made and made with the help of literary endearment as pretty well played out through over cultivation in literature as in agricultural pursuits. Divulgence of reports is essential if success is to be attained.

At the beginning of the sixteenth century surgeons were looking for other methods to express themselves. However, the chief part of the century was to bring forward his idea of the culture on but this was far too advanced thought and upholding in character to appeal to the rank and file of the profession as it was to be in the late century that John Hunter as the olive branch of the fundamental pathology of inflammatory conditions which he brought the surgeons something new to think about.

Laced with this condition of affairs the inner was apparently found in the fact that to be able the fashion to publish books containing the language of long lists of cases—many of them without any relation to another—and with any diversity of judgment drawn from them. They appear to be a great measure taken from an ethical and erasing standpoint relating to the only sort of cases—the more outstanding ones and making up the better—and calling particular attention to the great skill and ability of the author in the handling of the condition especially if several others had failed before he was called.

The work of Johann Meckrenon Jacob Meckrenon a Dutch Heelmeester or surgeon and anatomist of Amsterdam Holland who died in 1666 is a typical example of the Observations or Cosia of the seventeenth century. The work apparently appeared first written in Flemish for the title page reads

Th Medico Surgical Observations of Johann Meckrenon Surgeon of Amsterdam translated from

the Belgian into Latin by Abraham Blasius son of Gerard student of Medicine Amsterdam from the workshop of Henricus and the widow of Theodorus Broom 1668. Abraham Blasius dedicates his translation to his father Gerard who was an anatomist and annotator of the work of Vesling. For a time he posed as the discoverer of the parotid duct until Stenon in a letter to Bartholin disproved his claim.

Meckrenon in his preface states his belief that advance in surgery will best be gained by adding facts to fact until as he expresses it. If each one of us adds on grain of sand to the complement of the illustrious and noble Art of Medicine soon immense treasures and innumerable gifts will be brought together to fill the needs of our lives or fellow citizens and our posterity to cure disease successfully.

Meckrenon proceeds to his task after the usual manner of the time beginning with fractures of the skull and denigrating the matter with surgical diseases of the lower extremities. The translator had added some posthumous observations divided into chapters the first of which deals with monsters among which one of the most possible anomalies and some which may be placed in the realm of the visionary. The title page gives a fair deal of the type of case which is illustrated and described in the body of the work. The rather risky endeavor as a young surgeon aged 3 that Meckrenon's in consultation with several physicians in Amsterdam. He offers no explanation of the abnormality. The third patient from the right standing at the table was a young lady who had what Meckrenon describes as a cartilaginous nasal polyp which he moved through the mouth and the nasopharynx into the lung cavity. Of course the description of the procedure is exaggerated.

Meckrenon illustrates a glomeration of the wrist and thumb of a boy and it with a blow of the fist. He reduces fracture of the coccyx usually and performs many of the manipulations in common use today. When possible he obtained postmortem examinations and gives the findings but unfortunately they are so brief in many instances that it is difficult to make accurate diagnoses. Constantly throughout the work he quotes authorities going back to Hippocrates or some in the same direction referring to his contemporaries. One of the books with the feeling that Meckrenon has added far more than his own grain of sand to the complement of the illustrious and noble Art of Medicine.



JOBİ a MEEKREN  
OBSERVATIONES  
Medico Chirurgicæ

AMSTÆLÆDAMI  
Ex officina Henrici et Vidue Theodori Boom 1682



## REVIEWS OF NEW BOOKS

THE idea of Crowe<sup>1</sup> to combine under the same cover the subjects of bacteriology and surgery of chronic arthritis is unique and commendable. In view of the stress of tremendous specialization of the present day when bacteriology is read and delved further into bacteriology only and surgeons restrict their studies to problems of essentially surgical kind, this excellent work will make the surgeon and the bacteriologist acquainted with each other's problems of a surgical kind. Closer union through more common interest and prolonging of co-operation over a period of time between surgeon and bacteriologist undeniably promotes intelligent treatment surgically of the chronic arthritis.

The book gives a composite classification of arthritis with a comprehensive discussion and profuse reference to the literature. The chapter on arthritis sets forth the present day views of many writers on the subject together with the classification of arthritis. In addition it gives the author's opinion that both staphylococcus and streptococcus are the etiologic factors in the production of arthritis.

It seems to me to be unfortunate that the section written by Dr. Price on dental infection has been allotted so much space as it tends to convey the impression that his opinion is far more important than is generally credited by his confreres in oral surgery.

It is the reviewer's impression that in the chapter on surgery the discussion of surgical technique will be of little value to the surgeon. The bacteriological discussion should however be of great value in affecting surgical judgment as to operative indications.

Essentially this book is an endeavor to clear up the hazy ideas of the streptococcus and to give us a new classification. While the author's method will not be the last word it will serve as a stepping stone for other bacteriologists to carry on blazing new trails in our present jungle of facts and ideas on this subject. The work of compiling this book represents the laborious assembling of hitherto scattered information. The comprehensiveness and the simplicity of style of this book make it very readable. The author should be commended for his sincere purpose of searching for truth.

One of the most worthwhile results of a work such as this is to focus attention on the necessity for closer contact between the surgeon and the bacteriologist with the purpose of having the bacteriologist render an opinion which is much more personal and cognizant of the case in hand than is the present impersonal academic decision not referable to any particular individual.

The book is of little value from the point of view of surgical technique but does serve to revise and bring up to date a surgical concept of the rôle of streptococcus in arthritis and bone and joint surgery.

LAURENCE H. MAYERS

THIS atlas by Bertwistle and Shenton<sup>2</sup> is an excellent graphic exposition of the subject of typical X-ray examples of normal and abnormal lesions. The atlas method commends itself in X-ray works that are intended as reference books as well as material for teaching roentgenological interpretation.

The authors have presented a very wide range of the practical application of the X-ray in diagnostic studies. The illustrations are of a high order each one is accompanied by a systematic analysis which adds greatly to the value of cases presented.

This combination of the clinical with the X-ray features is illustrative of what should be more generally practiced by the referring physician and the roentgenologist. The closer co-operation of clinician and laboratorian will result in a better understanding of the more minute details of the patient's condition and will give the best possible results. The book is divided into anatomical systems each of which is adequately covered by splendid illustrations and explanatory text. The authors show among other applications of the X-ray in diagnosis the use of lipiodol in lesions of the nervous system but do not include the important injection of this material in the respiratory tract which is now being used with increasing frequency by American roentgenologists and thoracic surgeons.

EDWARD S. BLAINE

THIS eighth edition<sup>3</sup> of the synopsis of surgery has little over two pages more than the seventh. The material is utilized in an excellent discussion of poliomyelitis. Further changes are—a revision of the chapter on hydrocephalus which is improved by a classification according to etiology and mention of the Graham Cole method of cholecystography. Save the changes here mentioned the text is identical with the previous edition.

SAM FOGELSON

THE eighth edition<sup>4</sup> of *Diagnostic Chirurgical* is represented by a large volume of 131 pages. It has undergone considerable change since its first appearance in 1895. The work is characterized by considerable diagnostic skill; the diagnosis of various surgical conditions is treated in the complement

A D I T T V A L A C E R A R A By A P B t  
w l H B Ch B F R C S (Ed.) d E W H Sh t M R C S t  
L R C P S L B 15 T b C V M o b y C m p y 96

A S p s b S G By F r n e s t W H y G e s M S M D  
B S C (L d) F R C S (F g) 8th ed N w l C W l m W o o d  
d C m p y 97

D i a o n C C (D p l a R o c h d D m l W o o d)  
8th ed t l y b y W M S t P J G a s t D t C S t S

B C T E L o c D S u r C h A T H T i D R h V  
I S M W T H E D R E U L T E A M T B y H W C D M  
B C H (O ) M R C S J R C P T b C h p t S g I T t m t  
by H b e t f k l i n g C B E M R C S (E g)



possible fashion. Characteristic of French works on surgical diagnosis, the field of gynecology is likewise included. The book is illustrated by numerous well selected and instructive pictures. The radio-grams however are of a poorer inferior quality.

GERHIERIN

**I**N a valuable and interesting monograph, I analyze his experience with the surgical treatment of gastric cancer. The text illustrates by excellent pictures of the successive stages of the operation of gastric resection. In fact, it appears to be the more valuable part of the monograph. So far as the technique of the operation is concerned, a special emphasis is laid upon the retention of the great omentum along with the stomach, as to remove possible lymph metastases. Iauhet presents an anterior gastroenterostomy with the inclusion of Bannabulay enterotomy. He is an enthusiastic advocate of the exploratory laparotomy. His indications for resection are broad. In his operative material, the mortality amounted to 7 per cent whereas the number of cases included in a 5-year limit was 33 per cent. A remarkable result. The monograph is complete in an instructive, biopathological study. H. R. Hberg.

(RE) II.  $E$  IS

American surgeons—Major Alb. J. Laidlaw and Bloodgood—s not contribute to England and France contributed important articles. Of the many excellent Italian authors on canal select a few for special mention. O. Mangani has an excellent paper on retroperitoneal ligation of cysts and the treatment of Lutter's tumor. The early cure of congenital luxations of the hip. U. Archangeli reviews the subject of osteomalacia. Artom di Sant'Agnes addresses the transvascular and transvescoperitoneal route for the repair of obturator vesicovaginal fistulae. Reports of cases of which 6 were successful. R. Falcone contributes a new method for the cure of hypospadias using the scrotum for the formation of a double pericled new canal. He first sutures the new canal with the skin outside, waits 4 to 5 weeks for the recanalization to be re-established and stimulates proximal canalization in the new canal by applying intermittent elastic constriction on its distal end. The final step in his operation consists in separating the distal end of the canal splitting it longitudinally with scissors and resuturing it with the skin inside. The formation of the penile canal and a choicing of the new tube are carried out according to classical technique. Falcone reports successful cases.

G Egidi reports 10 cases of umbilical hernia permanently cured through the use of pedunculated strips of rectus fascia which he criss crosses over the umbilical opening through two stab wounds in the rectus fascia. In this work he was inspired by L. L. McArthur's work on autoplasmic sutures published in 1901.

GEO GE DE TARNOWSKI

EMERSON S recently published textbook on physical diagnosis is in contrast to many of the more recent works on physical diagnosis a really painstaking and detailed discussion. It represents the point of view that in spite of the enormous advances in scientific medicine in the laboratory and at the bedside physical diagnosis by the eye and hand still remains the basis of correct medicine. Fully one third of the work may be said to be devoted to the results of inspection—that is general physical characteristics, skin diseases and signs of phenomena to be seen in different parts of the body. This is as it should be since inspection is the most neglected and perhaps the most valuable form of physical examination. One might question the use of 75 pages devoted to the description of skin lesions as being out of place in such a work.

A broad foundation for the student is laid by the introduction of many subjects not strictly a part of manual diagnosis such as a history of physical diagnosis and a discussion of types of growth, body posture, fever and blood pressure. The character of the literature is thorough and detailed. The printed pages are sprinkled with phrases and headings in bold type. The classical signs of various lung findings are presented with many diagrams. The section on heart as well as the rest of the work is well illustrated. The discussion is complete to illustrate the technique for taking and observations on the characteristic of the pulse are discussed for 6 closely filled pages. This does not include a discussion of pulse arrhythmias. Frequent interesting and sound though not conventional opinions are presented for instance. It is not true that thickening of the vessels is an almost physiological process. A truly normal man of various ages the presence of respiratory variations of the pulse would indicate a so-called rather than an injured heart. A demonstrable enlargement of the heart is always due to cardiac dilatation and a tremethypertrophy alone could increase the cardiac shadow scarcely perceptible meter.

There is some question as to how this book should be used. Certainly according to my experience as a student and judging by the knowledge of interests and students of the present physical department, it is not receiving the attention which it should. If this book is to be used by students for more time should be spent in didactic teaching of physical diagnosis and with such a work it could well be made one of the major subjects of the clinical classes of medical

G C ER E MA B V t P h d A H lbe g F  
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J B Lpp C 8

school. It does not seem that the work is quite extensive enough to be used as a final reference work, although apparently every phenomenon is at least mentioned. It is a book which should certainly be considered by any one interested in teaching or studying physical diagnosis. PAUL STARR

**KERS** valuable manual on acute contagious diseases has appeared in its third edition since 1911. It is composed of a rather discursive introduction and a chapter of advice on the observation of rashes and throats and then successive brief clear descriptions of measles, rubella, scarlet fever, smallpox, vaccinia, chickenpox, typhus fever, enteric fever, diphtheria, erysipelas, whooping cough, mumps and cerebrospinal meningitis. A photo-

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MD (Lo d) MRCS (E g) L R C P (Lo d) D F H 3d d N W  
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graph of the rash or distinctive lesion in each of these conditions is reproduced.

This manual has been brought up to date by Dr Rundle and includes a description of the more recent immunological advances in the treatment of these fevers. He is possibly not as enthusiastic concerning active immunity as prophylaxis in diphtheria as our American writers but nevertheless admits its success. He is still more conservative in regard to the specific antiserum in the treatment of scarlet fever which to us seems to be eminently successful. Likewise in the treatment of erysipelas he rather discourages the use of an antiserum although recent American experience indicates that very successful results may be obtained with a new antiserum.

Except for such differences of opinion the book is a very valuable description of these common diseases and should continue to be of use to students and practitioners. PAUL STARR

## BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

**DIE TECHNIK DES ORTHOPAEDISCHEN EINGRIFFS. FÜNF OPERATIONSLEHRE AUS DEM GESAMTGEBIET DER ORTHOPAEDIE.** By Dr Philipp J. Erlacher. Vienna. Julius Spinnler, 1928.

**THE MATERIAL AND METHODS OF THE GYNCOLOGICAL AND OBSTETRICAL DEPARTMENT IN THE UNIVERSITY OF LIVERPOOL.** By W. Blair Bell, B.S., M.D. (London). Hon. F.A.C.S. Manchester. Sherratt & Hughes, 1928.

**BIOLOGIE UND PATHOLOGIE DES WEIBES. EIN HANDBUCH DER FRAUENHEILKUNDE UND GEBURTSHILFE.** By Josef Halban and Ludwig Setz. Lieferung 43. Berlin and Vienna. Urban & Schwarzenberg, 1928.

**LES TUMEURS VILLEUSES DU RECTUM.** By Andre Lamblang. Paris. Masson & Cie, 1928.

**DIATHERMY: ITS PRODUCTION AND USES IN MEDICINE AND SURGERY.** By Elkin P. Cumberbatch, M.A., B.M. (Oxon.). D.M.R.C. (Camb.). M.R.C.P. 2d ed. St. Louis. The C.V. Mosby Co., 1928.

**A HANDBOOK OF CLINICAL GYNCOLOGY AND OBSTETRICS.** By Rae Thornton LaVake, A.B., M.D., F.A.C.S. St. Louis. The C.V. Mosby Company, 1928.

**THE DUODENUM: MEDICAL, RADIOLOGIC AND SURGICAL STUDIES.** By Pierre Duval, Jean Charles Jour, and Henri Bécère. Translated by E. P. Quinn, M.D., St. Louis. The C.V. Mosby Company, 1928.

**OPERATIVE SURGERY.** By J. Shelton Horsley, M.D., F.A.C.S. 3d ed. St. Louis. The C.V. Mosby Company, 1928.

**COLLECTED PAPERS OF THE MAYO CLINIC AND THE MAYO FOUNDATION.** Edited by Mrs. M. H. Mellish and H. Burton Logie, M.D. Vol. XI, 1927. Published May 1928. Philadelphia and London. W. B. Saunders Company, 1928.

**SURGICAL PAPERS.** By William Stewart Halsted, Vol. I and II. Baltimore. The Johns Hopkins Press, 1924.

**CLINICAL MEDICINE.** By Oscar W. Bethea, M.D., Ph.G., F.C.S., F.A.C.P. Philadelphia and London. W. B. Saunders Company, 1928.

**A MANUAL OF SURGICAL ANATOMY.** By Charles R. Whittaker, F.R.C.S. (Edin.), F.R.S.E. 4th ed. rev. and enlarged. New York. William Wood & Company, 1928.

**ANNUAL REPRINT OF THE REPORTS OF THE COUNCIL ON PHARMACY AND CHEMISTRY OF THE AMERICAN MEDICAL ASSOCIATION FOR 1927 WITH THE COMMENTS THAT HAVE APPEARED IN THE JOURNAL.** Chicago. American Medical Association, 1928.

**NEW AND NONOFFICIAL REMEDIES 1928.** Containing Descriptions of the Articles Which Stand Accepted by the Council on Pharmacy and Chemistry of the American Medical Association on January 1, 1928. Chicago. American Medical Association, 1928.

**NURSES' PATIENTS AND POCKETBOOKS.** Report of a Study of the Economics of Nursing Conducted by the Committee on the Grading of Nursing Schools. May Ayres Burgess, Director. New York. Committee on the Grading of Nursing Schools, 1928.

**THE NOSE, THROAT AND EAR.** By John F. Barnhill, M.D., F.A.C.S. New York and London. D. Appleton and Company, 1928.

**THE EYE.** C. W. Rutherford, M.D., F.A.C.S. New York and London. D. Appleton and Company, 1928.

**INTERNATIONAL CLINICS. A QUARTERLY OF ILLUSTRATED CLINICAL LECTURES AND ESPECIALLY PREPARED ORIGINAL ARTICLES ON TREATMENT, MEDICINE, SURGERY, ETC.** Edited by Henry W. Cattell, A.M., M.D. with the collaboration of others. Vol. 11, 38th series, 1928. Philadelphia and London. J. B. Lippincott Company, 1928.

**ADDRESSES ON SURGICAL SUBJECTS.** By Sir Berkeley Moynihan, Bart. Philadelphia and London. W. B. Saunders Company, 1928.

**GYNCOLOGY.** By William I. Graves, A.B., M.D., F.A.C.S. 4th ed. thoroughly rev. Philadelphia and London. W. B. Saunders Company, 1928.

**METHODS AND PROBLEMS OF MEDICAL EDUCATION.** 9th Series. New York. The Rockefeller Foundation, 1928.

**BEITRÄGE ZUR KENNNTNIS DER BEKANNTEN UND BEKANNTE UNTERSUCHUNGEN ÜBER DIE ANATOMIE UND ENTSTEHUNG MECHANISMUS DER KOMPLIKATIONEN DER BEHANDLUNG UND DIE PROGNOSE.** By Anders Westerborn. Uppsala. Almqvist & Wiksells, 1928.

# CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

GEORGE D STEWART New York *President*

FRANKLIN H MARTIN Chicago *Director General*

## BOSTON COMMITTEE ON ARRANGEMENTS

FREDERIC J COTTON *Chairman*

CHARLES G MIXTER *Secretary*

JOHN D ADAMS  
NATHANIEL AINS  
FRANKLIN G BALCH  
ALEXANDER S BEGG  
J EMMONS BRIGGS  
DAVID CHEEVER  
ARTHUR L CHITTL  
J H CUNNINGHAM  
HARVEY CUSHING  
LESLIE COLN DAVIS

HILBERT I DAY  
CHARLES S DEFRIN  
I W DUCKERIN  
A W DUDLEY  
DAVID EUSALL  
J H I C LOTHWAIT  
WILLIAM I CRAVES  
J HERT B CREEGLIGH  
OIT J HERMA  
DAVID F JOE

WILLIAM L LADD  
FRANK H LAHEY  
HALSEY B LODER  
FRED B LUND  
R H MILLER  
W J MIXTER  
H I MOSHER  
DAVID MUNRO  
FRANKLIN S NEWELL  
R B OSGOOD

WILLIAM C QUINBY  
CHARLES L SCLODDER  
JOSEPH L STANTON  
A WARREN STEARN  
JAMES S STONE  
LORING T SWAIN  
HAROLD WALKER  
WYMA WHITTEMORE  
HANS ZINSSER

## PLANS FOR THE 1928 CLINICAL CONGRESS IN BOSTON

FOR the eighteenth annual Clinical Congress of the American College of Surgeons to be held in Boston October 8th to 12th the clinicians of that city are keenly interested to present a program that will completely represent the clinical activities of that great medical center in all departments of surgery. The program is being prepared under the direction of a representative group of clinicians with Dr Frederic J Cotton as Chairman of the Committee.

In the following pages is presented a preliminary program of clinics and demonstrations. These schedules are to be revised and amplified during the next two months. The real program of the Congress will be issued daily during the Congress—each afternoon there will be posted at head quarters in the form of bulletins a complete and accurate schedule of the clinics and demonstrations for the succeeding day. A printed program will be issued each morning. Clinics will be given in the various hospitals beginning at 8 o'clock on Monday afternoon and will continue through the mornings and afternoons of the following four days.

General headquarters for the Congress will be established at the Statler Hotel where the ball room foyer and other large rooms on the mezzanine floor have been reserved for use by the Congress for registration and ticket bureaus bulletin boards technical exhibits executive

offices etc. The ballroom at the Copley Plaza Hotel will be utilized for hospital conferences evening meetings and other large assemblies.

A special feature of the program which will be of interest to all surgeons will be the celebration of Lister Day at the Massachusetts General Hospital on Friday. At the exercises to be held in the Dome Room in the old building of the hospital where ether was first administered for the production of surgical anesthesia on October 16 1846 there will be presented to the hospital a bronze bust of William T G Morton.

Since the last session of the Clinical Congress a number of surgical films produced under the supervision of and approved by the American College of Surgeons have been completed and will be given a premier showing at the Boston meeting.

### EVENING MEETINGS

There will be evening sessions on each of the five days. On Monday evening the Presidential Meeting will be held in Symphony Hall on which occasion the President Elect Dr Franklin H Martin of Chicago will be inaugurated and deliver the annual address. The Murphy Oration on Surgery will be delivered on the same evening by Professor Vittorio Putti Professor of Orthopedic Surgery in the University of Bologna Italy and Director of the Rizzoli Institute. On Tuesday Wednesday and Thursday evening sessions will

be held in the ballroom of the Copley Plaza Hotel. At the Wednesday evening meeting the visiting surgeons will be the guests of the Boston Surgical Society at a special meeting when the Bigelow Medal is to be awarded. On Friday evening the annual convocation of the College will be held in Symphony Hall when the 1928 class of candidates for Fellowship in the College will be received. The fellowship address will be delivered by Dr. William J. Mayo.

#### HOSPITAL CONFERENCE

An interesting series of papers, round table conferences and practical demonstrations that deal with many of the problems related to hospital efficiency is being prepared for the annual hospital conference which opens on Monday morning with a session in the ballroom of the Copley Plaza Hotel. Morning and afternoon sessions in the same room are planned for Tuesday, Wednesday and Thursday.

A special session of the hospital conference on Wednesday afternoon will be devoted to a symposium dealing with the standardization of the ophthalmological and otolaryngological departments in general hospitals.

The program for the conference is planned to interest not only surgeons but also hospital trustees, executives and personnel generally, and an invitation is extended to all persons who are interested in hospital activities to attend the conference.

#### REDUCED RAILWAY FARES

The railways of the United States and Canada have authorized reduced fares on account of the Boston session of the Clinical Congress so that the total fare for the round trip will be one and one half the ordinary first class one way fare. To take advantage of the reduced rates it is necessary to pay the full one way fare to Boston, procuring from the ticket agent when purchasing ticket a convention certificate which certificate is to be deposited at headquarters for the use of a special agent of the railways. Upon presentation of a visé certificate to the ticket agent in Boston not later than October 16th a ticket for the return journey by the same route as traveled to Boston may be purchased at one half the regular one way fare.

In the eastern, central and southern states and in the eastern provinces of Canada tickets may be purchased between October 4th and 10th; in the south western and western states between October 3d and 9th; and in the far western states and western provinces of Canada between September 30th

and October 6th. The return journey from Boston must be begun not later than October 16th.

The reduction in fares does not apply to Pullman fares nor to excess fares charged for passage on certain trains. Local railroad ticket agents will supply detailed information with regard to rates, routes, etc. Stop overs on both the going and return journeys may be had within certain limits.

Full fare must be paid from starting point to Boston and it is essential that a convention certificate be obtained from the agent from whom the ticket is purchased. These certificates are to be signed by the general manager of the Clinical Congress and visé by a special railroad agent in Boston during the meeting. No reduction in railroad fares can be secured except in compliance with the regulations outlined and within the dates specified. It is important to note that the return trip must be made by the same route as that used to Boston and that the certificate must be presented during the meeting and return ticket purchased and used not later than October 16th.

An exception to the above arrangement is to be noted in the case of persons traveling from points in the Pacific Coast states and British Columbia who will be able to purchase round trip summer excursion tickets which will be on sale up to and including September 30th with a final return limit of October 31st. The summer excursion fare is somewhat lower than the convention fare mentioned above but is available only in the Pacific Coast states and British Columbia. Tickets sold at summer excursion rates permit traveling to Boston via one direct route and returning via another direct route with liberal stop over privileges.

#### LIMITED ATTENDANCE—ADVANCE REGISTRATION

Attendance at the Boston session will be limited to a number that can be comfortably accommodated at the clinics; the limit of attendance being based upon the result of a survey of the amphitheaters, operating rooms and laboratories in the hospitals and medical schools as to their capacity for accommodating visitors. Under this plan it will be necessary for those who wish to attend to register in advance.

Attendance at clinics and demonstrations will be controlled by means of special clinic tickets which plan has proved an efficient means of providing for the distribution of visiting surgeons among the several clinics and insures against overcrowding the number of tickets issued for any clinic being limited to the capacity of the room assigned to that clinic.

## REGISTRATION FEE

A registration fee of \$5.00 is required of each surgeon attending the annual Clinical Congress such fee providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued which receipt is to be exchanged for a general admission card upon his registration at headquarters during the meeting. This card which is nontransferable must be presented to secure clinic tickets and admission to the evening meetings.

## BOSTON HOTELS AND THEIR RATES

Since the last Clinical Congress in Boston in 1922 a number of new hotels have been built including the Statler with 1300 guest rooms, the New Parker and the Ritz Carlton. Some of the older hotels have been enlarged so that there are now ample first class hotel accommodations in Boston for all who wish to attend. Many of these hotels are located within short walking distance of the headquarters hotels.

	R	M	m
	es	h	B h
	5	Double	
	Room	Room	
Hill	1 Bea St	\$4.00	\$7.00
Br em e	404 Comm nw lth A	4.00	.00
Bru w k	B y l t n nd Cla endon Sts	3.50	5.00
B km st	645 Be co St	3.00	4.00
Cante b ry	4 Charl gate W st	4.00	5.00
Ch l gat	Ch l g t Ea t M lb ro		
d B	n Sts	3.00	5.00
C pl v Il	Copl y Squ	4.00	7.50
Ilk	75 T emont St	3.50	5.00
I g t	534 B n St	4.00	5.00
Craly	Ch l gat W t	3.00	5.00
K m	490 Comm nw lth A e	3.50	6.00
L no	E t r i B y l t Sts	3.50	4.50
I i h	Ch r l St	4.00	6.00
N w I k	T m t d School Sts	3.50	5.50
Iu ta	39 C mm nw alth A	3.50	5.00
R tz C	lt A l g t a d N wbury St	5.00	8.00
Sh to	9 B y St t R d	5.00	6.00
S m set	400 C mm n lth A e	3.00	5.00
St tl r	I a k Sq a at A l gton St	3.50	5.50
T i	B y l to nd T n o t Sts	5.00	7.50
V d m	C mm nw lth nd Da tm th	8.00	6.00
V t i	D tmo th d C mmo lth	4.00	6.00
We tm	t Copl y Sq	3.00	5.00
A m	pl		

## PRELIMINARY CLINICAL PROGRAM

## GENERAL SURGERY GYNECOLOGY OBSTETRICS UROLOGY ORTHOPEDICS

## PETER BENT BRIGHAM HOSPITAL

## Monday

- HARVEY CUSHING—2 30 Neuro surgical clinic  
 FRANCIS NEWTON—3 30 Diverticulitis  
 CHANNING BROTHINGHAM—4 Passing of the chronic appendicitis  
 E. S. EMERY, JR.—4 30 Study of the results of medical and surgical treatment of peptic ulcer

## Tuesday

- Staff—9 30 Surgical operations  
 H. A. CHRISTIAN—2 30 Medical diagnostic and therapeutic clinic  
 GILBERT HORRAX—3 30 Cordotomy for the relief of pain  
 J. P. O'HARE—4 Hypertension and nephritis in relation to surgery  
 DAVID CHEEVER—4 30 Surgical diagnostic clinic

## Wednesday

- Staff—9 30 Surgical operations  
 M. P. SOSMAN—30 X-ray study of massive atelectasis of the lung  
 G. P. GRABFIELD—3 Effect of drugs on the nitrogen metabolism  
 JOHN HOMANS—3 30 Treatment of varicose ulcer  
 S. A. LEVINE—4 Heart disease in surgery  
 S. B. WOLBACH—4 30 Demonstration in surgical pathology

## Thursday

- Staff—9 30 Surgical operations  
 W. C. QUINBY—2 30 Surgical clinic  
 R. H. FITZ—3 Insulin in surgical conditions  
 WILLIAM MURPHY and JOHN POWERS—3 30 Treatment of secondary anemia by liver diet  
 HARVEY CUSHING and TRACY PUTNAM—4 Pituitary gland and its influence on growth

## MASSACHUSETTS GENERAL HOSPITAL

## Monday

- Orthopedic service—2 Dry clinics  
 NATHANIEL ALLISON Tuberculosis of the knee  
 P. D. WILSON Tuberculosis of the spine  
 DR. M. N. SMITH-PETERSON Tuberculosis of the sacroiliac  
 R. K. GHORMLEY Internal derangement of the knee joint  
 NATHANIEL ALLISON and DR. KLEIN Congenital dislocation of hip  
 Surgical service—2 Dry clinics  
 J. H. MEANS, E. P. RICHARDSON and GEORGE HOLMES The thyroid  
 GEORGE McIVER Burns  
 DRS. WHITE and SPRAGUE The heart in surgery  
 C. M. JONES The gall bladder  
 J. H. MEANS Surgical cases

## Tuesday

- J. D. BARNEY and staff—9 Genito-urinary operations  
 Surgical service—11 Surgical operations  
 D. I. JONES—2 Dry clinic Cancer of the gastrointestinal tract  
 C. A. PORTER—2 X-ray burns

- W. J. MIXTER, J. B. AYER and J. S. HODGSON—Surgery of the nervous system, operations and demonstrations  
 J. A. MEIGS—2 Uterine bleeding etc.  
 L. S. McKITTRICK—2 Radium in cancer of the rectum  
 ARTHUR ALLEN and R. H. SMITHWICK—2 Circulatory diseases of the extremities postoperative pulmonary infections

## Wednesday

- DRS. WILMAN WHITTEMORE, CHURCHILL and LORD—9 Thoracic surgery operations  
 R. C. CABOT and MISS CANNON—Social service  
 DR. BREWSTER—2 Surgical clinic  
 DR. LLOYD and associates—2 Syphilis and surgery  
 F. A. WASHBURN—2 Early days of the Massachusetts General Hospital first ether anesthesia  
 DR. SIMMONS—Surgical cases  
 WILLIAM HERMAN—2 Psychiatry and surgery  
 DR. HOLMES and associates—Demonstration in X-ray department

## Thursday

- Orthopedic service—9 Operations and demonstration of cases  
 DRS. WILSON and DANFORTH Arthritis of the spine  
 NATHANIEL ALLISON and DR. COONSE Arthritis of the knee  
 WILLIAM ROGERS and DR. STRAUSS Arthritis of the hip  
 R. K. GHORMLEY and DR. LOW Poliomyelitis  
 WILLIAM ROGERS End result studies  
 Fracture service—2 Demonstration of cases  
 DRS. VINCENT and A. V. BOCK—2 Dry clinic The spleen  
 E. P. RICHARDSON—Hernia through the cardiac orifice of the diaphragm  
 LINCOLN DAVIS—2 Cancer of the caecum, duodenum and gall bladder  
 DR. HANFORD (Presbyterian Hospital, New York) and RICHARD MILLER—2 Clinic on surgical tuberculosis  
 DR. DALAND—2 Clinic on plastic surgery  
 DR. SHEDDEN—2 Surgical clinic

## Friday

- Staff—9 Surgical operations  
 G. A. LELAND—12 Fascia repair of hernia  
 DRS. C. A. PORTER, BREWSTER, JONES, DAVIS, RICHARDSON and WILLIAMS—11 Surgical clinic  
 R. B. GREENOUGH and associates—2 Tumor clinic  
 DR. McIVER—Gastrointestinal surgery  
 DR. WILLIAMS—2 Gall bladder surgery  
 DR. AUB—2 Clinic on occupational diseases, calcium metabolism in bone  
 A. V. BOCK—2 Surgical clinic  
 DR. HARMER—2 Surgical clinic

## CAMBRIDGE HOSPITAL

## Tuesday

- Staff—9 General surgical clinics, operations and demonstration of cases

## Wednesday

- J. W. SEVER and F. A. FENDELAY—9 Orthopedic clinic, operations and demonstration of cases

## Friday

- Staff—9 General surgical clinics, operations and demonstration of cases

## LONG ISLAND HOSPITAL

M d y

J H CUNNINGHAM a d C S Sivan— C t o u r r y  
 l c o p e t i o d d m t r a t f  
 LAWR CE W SMITH— P t h l o g l d m n t r t n  
 HENRY VIETS— N o u g l  
 A B MACMILLAN— \ y d m o t t

H d d y

ROBERT SOUTHER— O t h p d e l o p e r a t a d  
 d m t t o f c f c t n t h t m t f  
 f r a t u t t m n t f g i t h p  
 LAWR CE W SMITH— P t h l a l d m t r a t n  
 HE RY VIETS— N g l  
 A B M C MILLAN— \ v d m t t  
 CHARLES LUND— I j t t t m t f  
 p t i o n d d m t t n o f c a

F d y

J H CUNNINGHAM d C S Sivan— C t o u r r y  
 p e r a t  
 ROBERT SOUTHER— O t h o p d p e t  
 CHARLES LUND— G l g l p e t  
 LAWR CE W SMITH— P t h l g l d m t t o  
 HENRY VIETS— N u r o g l  
 A B MACMILLAN— \ y d m t t

## ST ELIZABETH'S HOSPITAL

T d y

G F K FAN— S g l l c A p p e d t m y h  
 t t m y  
 JOS. STANTON— S u g a l l T h l c  
 g a t o e t t m y  
 W F DOLAN— S g i c a l c I g u l h  
 C J KICKAP— P r o f p f t r u  
 F T JANE— I g u l h d l l a x t h  
 H S POLE— A p p n d t m y  
 A L CHUTE— d B D W t r L— D y l n  
 G n t u r y d u l t d u l r t  
 g g r a m  
 T J SCULLEN— C y n e c l g l m t t  
 PIERCE DUNPHY— C f f r a p e r a t o n  
 d \ y t h p y t f o y f t p a t  
 PIERCE MCGANN— P t p e r a t h y p p d

H d s d y

F T JANE— S g l l c A p p e d t m y h l  
 c v t t m y  
 C F KEENAN— S g l l c C h o l c y t t m y  
 PIERCE DUNPHY— P l p l t a r e a t  
 JOSEPH STANTON— T h y r d s  
 R SULLIVAN— k t l g  
 T F BRECKEN— R t r u c t o f h p p l t o  
 k n j t  
 T F BRECKEN— d R F SULLIVAN— D y l n c  
 E d l t s p l f f o t u b l s c l  
 d t m l m l d u l t p l t  
 f l f f d f r m t y  
 F T JANE— F d l t n f t p e r a t d  
 n o p a t l l d l l d t m t f m l g n t  
 DR HEALY— I t t g n t g o r m  
 JOHN DUNPHY— S l p e t f p d t

Tl d y

T F BRECKEN— S g l l n c S p l f  
 A L CHUTE— P t t t m y t m f b l d d  
 n p h e t o m y

JOS. STANTON— C a t t t m y c h l c y t c  
 t o m y a p p d t m y  
 H S POLE— I l v t c t o m y  
 G F KEENAN— O i a c y t  
 A H CRIBBIE— N p h c c t m y  
 JOSEPH STANTON— D y l H g l s t m h  
 f l o m f l w i t h i t m t t e n t i t p t  
 J J SULLIVAN— F o r m f l l o w g a d m t t o f  
 a l k a l f t a t m t f d u o d a l u l e r  
 L J LOUIS— P o p e r a t u p e c t c y t  
 H S RYAN— S g l

F d y

L J LOUIS— S g a l c c A p p e d t m y h l  
 c y t t m y  
 H S RYAN— C l l y t c t m y  
 J J STANTON— A p p e l t m y h y t c t m y  
 C F KEENAN— A t r a l h a p p e n d c t o m y  
 C J KICKAP— C a a t  
 F T JANE— I g u l h m d r l o l t h  
 C F KEENAN— D y d P o t p e t i f r a t o f  
 k l l p t p e t n c t n o f c h t  
 M H SULLIVAN— E d r u l t n f t s o f k u l l

## ROBERT BRIGHAM HOSPITAL

T d y

H A NICHOLSEN— F l f t n c h c t h n t  
 g a t t t l t d  
 H T STANTON— T y p f t h t w t h \ a y t d  
 a d t h o p d p p l n t h t a t m t

H d d y

P D WILSON— O p e t i o f k d f m t  
 H T STANTON— D m t t f t h p e d a p p a r a t

Tl d y

L M SEAR— C l t o r y d t n t h t  
 L T BROWN— M h l d t f t h l w b k

F d

P D WILSON— O t h o p d p e t o d d m  
 t t f r t h p e d p c p l s n t h t t  
 m t f h r o t h t

## BOSTON DISPENSARY

T d y

H J INGLIS— L p d l j t t h d g l  
 b l t d l u g a b e d i o p t t  
 d p m t  
 ARTHUR H COLE— d HAROLD CHAMBERLIN— C y t  
 p y d d m t t n o f  
 JOSEPH H PRATT— D v l l m p t c f t h  
 p l y t t h g l l t t d b y c

H d d y

J H N D ADAMS— O t h p e d p e t s  
 H F D— I j c t t m t f a  
 n s d m t t o f t h q d p t h o  
 l g c l p e m  
 HARRY F JEDMAN— D m t t f m l g n  
 t t e d b y d m d \ y t h p y

Tl d y

A K PIERCE— T i n e m e n t o f g o h e e n w m  
 WILLIAM A HINTON— H t c h l t l t  
 d m o t r a t f t h q d l a t r e s e b l t y  
 M Y R LADD— S g a l p e t f p y l t  
 f t s

## BOSTON CITY HOSPITAL

## Monday

- N R MASON R M GREEN C T WILLIAMS F L  
GOOD J P COHEN H V HYDE and I J LYNCH—  
Gynecological and obstetrical clinic operations  
and demonstration of cases

## Tuesday

- H BINNEY A R KIMPTON H H HOWARD C W PAPPEN  
D D SCANNELL S FRASER J J HEPBURN and I T W  
WICKHAM—9 Surgical clinic operations and demon-  
stration of cases  
Surgical Services I and III—2 Dry clinic  
F W WHITE—2 Intussusception of the bow l occurring  
within the stomach following gastro enterotomy  
G C SHATTUCK— Surgical aspects of some tropical  
maladies

## Wednesday

- H B LODER J J WALKER F F HENDERSON E HARDING  
J C HUBBARD R C COCHRANE D MUNN A  
RILEY and T RICHARDS—9 Surgical clinic opera-  
tions and demonstration of cases  
Surgical Services II and V—2 Dry clinic  
G R MENDOT and J T WEAR—2 Dry clinic  
W R OHLER—2 The care of the surgical diabetic  
F B MALLORY— Pathological demonstration

## Thursday

- F J COTTON O J HERMAN J H SHORTALL and W  
MORRISON—9 Surgical clinic operations and demon-  
stration of cases  
D MUNRO and TRACY PUTNAM—9 Neurosurgical oper-  
ations  
Surgical Service IV—2 Dry clinic Neurosurgical cases  
S COBB and A MYERSON—2 Neurological clinic  
B BUTLER—2 Ray demonstration

## Friday

- F B MALLORY I F BUTLER F J COTTON R W  
ANDREWS and others—9 Conferences and presenta-  
tion of special subjects

## CARNY HOSPITAL

## Monday

- A R MACAULAND—2 Dry clinic Traumatic injuries  
of the hip joint illustrated  
H G LEE—2 Dry clinic Fractures of the femoral shaft  
and of the table of tibia with joint arthroplasties  
D F MAHONEY—2 Dry clinic Radical operations for  
carcinoma of the breast and perforating duodenal  
ulcer with presentation of cases

## Tuesday

- F B LUND A MCK FRASER and associates—9 Surgical  
operations  
F W JOHNSON L E PHANEUF and associates—9 Gynecological and obstetrical operations  
A L BRIT—2 Dry clinic Ununited fracture of neck of  
femur bone screws in fractures fusion of spine  
F B LUND L J DENNING and W E BROWN—2 Dry  
clinic Chronic duodenal ulcer  
F W JOHNSON— Dry clinic End results following in-  
terposition operation for uterine prolapse (lantern  
slides)

## Wednesday

- D F MAHONEY W E BROWNE and associates—9  
General surgical operations

- F W JOHNSON L W PHANEUF and associates—9 Gynecological and obstetrical operations

- P N JERSON—2 Dry clinic Relative value of various  
types of operative bone splinting including the mas-  
sive bone graft treatment of chronic arthritis of the  
spine operative and nonoperative incidence recog-  
nition and treatment of pterygoidolysis over correc-  
tion of deformities in fracture  
A MCK FRASER—2 Dry clinic Caecostomy in acute  
appendicitis with peritonitis presentation of case  
L E PHANEUF—2 Dry clinic The low or cervical cae-  
sarean section (lantern slides)

## Thursday

- F B LUND A MCK FRASER and associates—9 General  
surgical operations  
F W JOHNSON L E PHANEUF and associates—9 Gynecological and obstetrical operations  
W R MACAULAND— Dry clinic Mobilization of the  
knee and elbow  
M H BLOOMBERG—2 Dry clinic Scoliosis and club foot  
F J DENNING—2 Dry clinic Postoperative medical  
problems pre-operative treatment in cardiac cases  
L E PHANEUF— Dry clinic Uterine bleeding (lantern  
slides)

## Friday

- D F MAHONEY W E BROWNE and associates—9  
General surgical operations  
F W JOHNSON L E PHANEUF and associates—9 Gynecological and obstetrical operations  
A SARGENT and B A GODDYN—2 Orthopedic clinic  
E J DENNING—2 Dry clinic Intestinal parasites in  
immigrants  
W E BROWNE—2 Dry clinic Fractures and injuries of  
the hand and forearm with presentation of special  
splints  
L L PHANEUF—2 Dry clinic Appendicitis and preg-  
nancy

## MASSACHUSETTS HOMOEOPATHIC HOSPITAL

## Monday

- T E CHANDLER and H J LEE—2 General surgical  
clinic Operations and demonstration of cases

## Tuesday

- C T HOWARD and C CRANE—9 Surgical operations  
I C WIGGIN and S N VOSE—9 Urological operations  
S W ELLSWORTH—10 X ray demonstration  
S R MEAKER— Gynecological clinic  
J F BRIGGS and W K S THOMAS—2 General surgical  
operations

## Wednesday

- T E CHANDLER and C D HARVEY—9 Surgical opera-  
tions  
A G HOWARD S L MYRON and L G HOWARD—9  
Orthopedic operations  
C T HOWARD and H J LEE— Surgical operations  
L I JOHNSON—2 Bronchoscopic clinic

## Thursday

- J E BRIGGS and C CRANE—9 Surgical operations  
S R MEAKER—10 Gynecological clinic  
S W ELLSWORTH—10 X ray demonstration  
C T HOWARD and W K S THOMAS—2 Surgical opera-  
tions

## Friday

- T E CHANDLER and C CRANE—9 Surgical operations  
J L BRIGGS and H J LEE—2 Surgical operations



## IRISH HOSPITAL FOR WOMEN

Mo d y

D y l ic— D u s i o n f n p l l m g v n l g v

T d

Op rat l n i — o A m p u t t f c d c e l t m y  
 t t g o f p l n t p e n l p l y  
 t g f j o l t i l y t t m y f f b l d l t  
 t l r t t g c e l t m y f t )

H f d y

Op t l — o P l t l a l t m t  
 t p r t l y t t m y f f l i d l t t  
 d t t k l t m y f t r l o  
 l p l f m p l t t f l m

T l t

Op t l n — o A m p u t t f l l t m  
 f l l t l l l l x l t m f l l a p  
 t t t m f l l l r f

I d

Op t l — H t t m f l l t a t  
 l t t g l l l t f l f  
 D r y l — o D m t t f t t d

NEW ENGLAND HOSPITAL FOR WOMEN  
AND CHILDREN

T d

L D A B l A r p l C R i r — o  
 C l b l l r a t  
 B L A r y l M M N r — o  
 C w t o j t l l f l b l

H d d y

M A i N — D m t t f a l l t t r l  
 l j l k l t l l  
 L D A n B l A — o  
 G y l g l l t j C l

T l d

G R r l O r A l — o D t t f  
 p t p t f l l k l p m  
 E v e r i n B L y l l W r u t — o D t r t n f  
 l l l

## FORSYTH DENTAL INFIRMARY

Staff— d l S g l l l f t p l t p t  
 o o t r e s t D m t t n h l b a r  
 f f t f a d t b o d l p m t d p

## TUTTS COLLEGE MEDICAL SCHOOL

T m L A R — l l y D m t t f p m  
 l l t t k u l t f t m t m p e l l y  
 l b l

## NEW ENGLAND BAPTIST HOSPITAL

T d y

L L Y o u c J r D I J A C K S O N H B L o n r d D J  
 B i r o l J r — o C f g c a l f c p e a t  
 n l d m o s t a t f a s

H e d d y

F H I A l F A d H M C L U T T — o S u l o p t o  
 S R M J O R D A n d L K I E F F E R — 2 C t o e n t l g l  
 l

T l d y

F I Y a n g J D I J A C K S O N H B I o d e r n d D J  
 B r i t l J — o C n l s g e l c l c p t s  
 a l d m t t i o o f

## BOSTON HAVEN HOSPITAL

T d

S t f f — o D l  
 B F H A s t r H a t t h p g y  
 F S N l L T t m t o f p g y c m p l t d b y  
 h a t l

S B M E d l t j l m p t t o x m  
 I C I R c l t m t f j l m p t t x m b y t h  
 m l f l l o o l p l m a d t h f o f o  
 p l

F C C R r r C l l p e t f p y l u i p g n o  
 G C P r t T h p o t p t m l l d d

H d d y

Staff— o O l t t r l o p e a t

## NEW ENGLAND DIACONESS HOSPITAL

D I J s F A A H L A r A M C h r e d L E L A n  
 M K I T T E R C K — o l l y C r a l g a l l O p e  
 t o d d m t t f

Staff— l l D l S g y f d t t d b t  
 d t h y r o d m g t d d d l u l e

## BETH ISRAEL HOSPITAL

W y n W H I T T O R E l a s o i a t — o d l y G e r l  
 g l l  
 E G C r r — o d l y U l g e l c l  
 M R A P — o l l y O t h p l c l c  
 H R A N B D D m n t t i m d l h  
 d p a t m e t

## BOSTON UNIVERSITY SCHOOL OF MEDICINE

(L M m o l B l d i g)

S R M n l A W K o v — W d d y d  
 F d S t d t l t  
 A W R d C H L A A R C E — 2 W d d y n d  
 F d L l l g v

## SURGERY OF THE EYE EAR NOSE AND THROAT

## MASSACHUSETTS EYE AND EAR INFIRMARY

## Tuesday

## Ophthalmology

Staff—9 Operations and demonstrations of cases

J M WHEELER Plastic surgery  
G S DERBY Eye operations  
W H LOWELL Mydriatics  
J H WAITE Slit lamp demonstration  
E B DUNPHY External diseases  
R C CHEVEY Perimetry  
H K MESSENGER Physiologic optics  
P A CHANDLER Light sense  
T L TERRY Pathology  
IDA E RIDGEWAY Sight saving class

## Otolaryngology

PHILIP HAMMOND—9 Simple and radical mastoid operation

H A BARNES—9 Dry clinic Malignant diseases of the accessory sinuses exhibition of patient  
H P CAHILL—10 Dry clinic Wire gauze brain drain paraffin basket for lung graft of radical mastoid cavity lantern slides of brain cases  
G H TOBEY—11 Dry clinic Lateral sinus thrombosis the manometer test  
C B FAUNCE— Dry clinic Lipiodol injections in brain abscess  
D C SMYTH—3 Dry clinic Lipiodol injection in lung abscess

## Wednesday

## Otolaryngology

G H POIRIER—9 Mosher-Toti lachrymal sac operation  
F A SIMMONS—10 Tonsillectomy cases dissected and narrated  
G H POIRIER Sluder technique  
H P CAHILL LaForce technique  
P F MELTZER Removal with cautery snare  
A S MACMILLAN—11 Dry clinic Demonstration of accessory sinus and mastoid X rays

## Ophthalmology

Staff—9 Operations and demonstrations of cases  
W B LANCASTER Eye operations  
J B AYER and G S DERBY Nerve eye clinic  
MAUDE CARVILL Ocular tuberculosis  
J H WAITE Gullstrand ophthalmoscope  
P A CHANDLER Perimetry  
SAGHS External diseases  
H K MESSENGER Physiologic optics  
P A CHANDLER Light sense  
T L TERRY Pathology  
IDA E RIDGEWAY Sight saving class

## Thursday

## Otolaryngology

V H KAZANJIAN—9 Plastic operation  
D C SMYTH—9 Dry clinic Fluoroscope and removal of metallic foreign bodies  
H P MOSHER—10 Dry clinic Exhibition of esophageal trumets demonstration of fluoroscopic examination of the pharynx  
A S MACMILLAN—11 Dry clinic Lantern slide demonstration of esophageal cases

DR KIRBY—2 Demonstration of Bárány tests  
F F GARLAND—3 Dry clinic Infection of the submaxillary gland

## Ophthalmology

Staff—9 Operations and demonstrations of cases  
T B HOLLOWAY Thyroid eye cases  
A GREENWOOD Eye operations  
S J BEACH Refraction with angular type  
W B LANCASTER Muscles  
H B C RIMMER External diseases  
E B DUNPHY Perimetry  
H K MESSENGER Physiologic optics  
P A CHANDLER Light sense  
T L TERRY Pathology  
IDA E RIDGEWAY Sight saving class

## Friday

## Ophthalmology

Staff—9 Operations and demonstrations of cases  
F H VERHOEFF Eye operations  
H B C RIMMER Tear sac cases congenital acute chronic  
ARY SMITH Social work  
H K MESSENGER Physiologic optics  
P A CHANDLER Light sense  
T L TERRY Pathology  
IDA E RIDGEWAY Sight saving class

## Otolaryngology

V H KAZANJIAN—9 Dry clinic Correction of deformities of the face and nose lantern slide demonstration  
H P MOSHER—10 Dry clinic Punch tracheotomy  
A S MACMILLAN X ray of thymus (lantern slides)  
F E GARLAND—11 Histological exhibit of laryngeal instruments  
H P CAHILL— Dry clinic Lantern slide demonstration of serial sections of the ear  
D H WALKER—3 Dry clinic Lip reading and the deaf child

## MASSACHUSETTS HOMEOPATHIC HOSPITAL

## Tuesday

W D ROWLAND—9 Eye clinic  
F W COLBURN and H L BABCOCK—9 Aural clinic

## Thursday

W D ROWLAND—9 Eye clinic  
C SMITH C W BUSH E P JOHNSON P O PARPIS and W W WALKER—9 Nose and throat clinic

## Friday

W D ROWLAND J C STERNBERG H M SIMMONS and J J SKIRBALL—9 Eye clinic

## BOSTON DISPENSARY

## Tuesday

H J INGLIS—2 Beck-Schenck snare method of tonsillectomy

## Wednesday

JOSEPH J SKIRBALL—11 Eye clinic demonstration of cases external diseases perimetry ophthalmological co-operation with syphilis clinic

## HARVARD MEDICAL SCHOOL

M d y

H P M SH — L r y n log l d m t t C t  
f th a l u l t c e ph gu et p m l g th  
c e p l gu t b th l d m o t t n f th  
M o h e T t l a c h r y m l p e t t l g m th  
o d d i p s t g r a d t t t r u t i n l y g l o g y

T d y

C S D RAY—2 Ophth l m l g l i m o t t A t  
a c h d m n t t o f h t t h l t l g l  
l t r a t o v i d i d h l t h p t d m  
t a t f k t h l g t s e t h g f t h  
l g p t

D S V E R I O E F d T E R R D m t t f j t l g  
l l l s

D R S D B Y C A N D R a d M i O B R S g n f  
f t h l g t l i m t t f t h m t l l  
b y w h t m v b t e s t d

L C I E H O W E — Ophth l m g a p h t t t  
m t l l y t h t r y f l f t g u l l t t f  
t h f a t g u t o y t

H P M S H R — M h F t l h y m l a p e t  
d m t t n d

P E M E L T R A t m l h b t o f t m p o l b  
p m

H d d

H P M S E R — L a r y n g o l b l d m t t C t  
f t h l u l t c e p h g u t p m l g t h  
c e s p h g u t b t h d d m t r a t f t t  
M l f r t l h r y m l p e t t h g m t h  
l l p o t g d t t r u t l g l v

C B F A U N C — E x h b t f t m p l b t m

T l d y

G S D E R — Ophth l m l l d m t r t A  
t e s h d m t t f w h t t h l t h l g l  
l t a t y i s d n g d l d t h p t d m  
t t f k t h l g h t s t h b f l y  
l g n p t i

D R S V E R O E F F a n d T E R R D m t t n f p t h o l  
c a l l d

D R S D B Y C A T L d M i O B R I E S g n f  
f t h l g t d d m t t f t h m t h d  
b y w h c h t m y b t t d

L U C I E N H O W E — Ophth l m g g p h t u t  
m t l l y t h t r y f l f t g d l t f  
t h s f a t g u t o y t a

H P M O S I U R — D m t r a t o f m t h d n p o t  
g r a d t e t a c h g f l v g o l g y

O R L O U E — E h b t f t m p o l b o p m

F d y

C n f n n o t l r y n l g y n d p h t h l m o l g y f m  
g t o

## CARNEY HOSPITAL

T d y

W S L I E B M A N — O I y c p e t n s n l l m t r a t f  
X y l o a l t a d m a g n t t t f  
f o g b o d ' s

H d d y

E D H U R E Y d W S L I E B A N — O T y p a t  
n l d m n t t o n o f c a s

T l d y

W S L I E B M A N a d H B O R c t F F — O E y p e r a t n  
n d d m n t t i o n f c s

F r d y

W J S H E H A N n d F C M I N I E R — O t o l r y g l g c a l  
l n t

## ST ELIZABETH'S HOSPITAL

T d y

W T H A L E Y — O M s t l d t d l c

H d d s

P S M A D A M — O I n c l t f t h e y  
J B U R — O T l l t m v

F d y

W T H A Y — O F n t l i p r a t o  
J B R A N — O M s t l p e a t n  
W T H L E — E d l t d a l n o p t

NEW ENGLAND HOSPITAL FOR WOMEN  
AND CHILDREN

M A K E I n d I D K F R R — O T l d W d n s  
d v L n l t h t l o p e t d s  
d m o t t f a

## BOSTON CITY HOSPITAL

J J C O R E T T — O d l y E y l

## CARNEY HOSPITAL

E D H U R E Y — O d l y l l

## BETH ISRAEL HOSPITAL

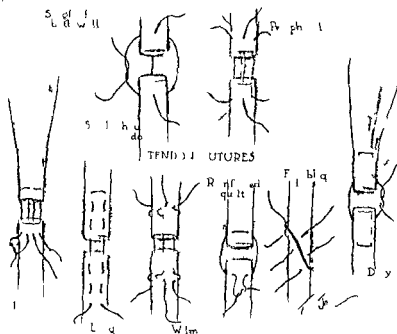
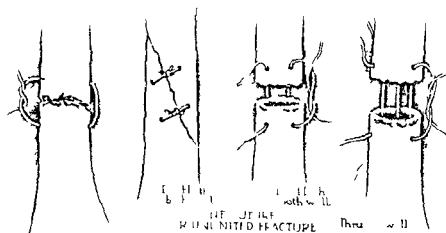
L A F R E D M d L A R A I N — O d l y N o a d t h r o t  
l n

## CAMBRIDGE HOSPITAL

N S B A C v l E J B L E R — O T l d y N d  
t h t l



LUKENS FICTORIAL TECHNIQUE  
BONE AND JOINT SERIES  
L. B. NELSON, D.D.S.



### Sutures with a Reputation

I      I : t f t l l l t v l t k t l y ld  
D i C D Wt l E C 408 I l l A St I U S A

l y h          l w l k

# SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE PUBLISHED MONTHLY

VOLUME XLVII

SEPTEMBER 1928

NUMBER 3

## SPINAL CORD SURGERY<sup>1</sup>

By ERNEST SACHS M.D. F.A.C.S. St. Louis, Missouri

IN an address before a general surgical society it would seem appropriate to dwell on the various types of spinal cord lesions that may be benefited by surgical intervention and to discuss operative results rather than to dwell on the points in diagnosis on which the neurological surgeon who does and ought to make his own neurological study has to spend much time and consider with meticulous care. There will always be times when it will be necessary for the general surgeon to do a laminectomy although I believe that the general surgeon feels about this branch of surgery almost as he does about cranial surgery—he now gladly turns over this work to the neurosurgeon. There is of course one great difference—the operation of laminectomy is generally comparatively simple and one does not meet the technical difficulties with it that are encountered in a cranial operation. The diagnosis however offers many pitfalls and it does not seem wise for a surgeon to be merely the hands which he must be if he has to depend on others for his diagnosis.

### INDICATIONS AND TREATMENT

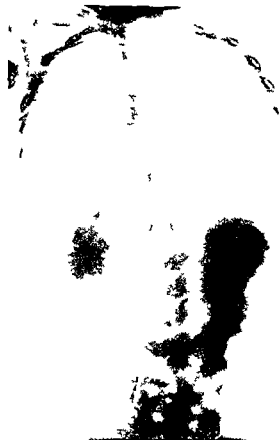
The conditions for which laminectomy may be required may be grouped under seven headings (1) fractures and dislocations of the spinal column (2) inflammatory processes meningitis and abscesses or solitary tubercles (3) compressions of the cord due to deformities (4) spasticities due to inflam-

matory diseases cerebral birth palsies or old injuries (5) spinal tumors (6) relief of intractable pain and (7) congenital defects (spina bifida).

The subject of fractures and dislocations with cord symptoms was discussed with some asperity before this organization several years ago when the subject was brought up by Dr. Coleman. It is universally agreed that when no spinal cord symptoms are present such as spastic paralysis sensory disturbances or bladder and rectal disturbances the problem is merely to deal with the fracture or dislocation by putting it at rest to institute supporting measures such as casts or braces and occasionally to strengthen the back with a bone graft.

How about the cases however in which cord symptoms are present? These are of two kinds those that present the picture of a complete block of the cord with complete motor and sensory paralysis and those in which there is evidence that the cord is not completely blocked because the patients have some sensation below the level of the injury or some motor power even if it be only the movement of a toe. In either group the disturbance may be due to pressure which causes an interference with function but there is no anatomical severance or there may be a partial or complete severance of the cord.

Suture of the cord does not lead to regeneration and restoration of function and is a useless procedure. A complete physiological



I g I l g l t l f l t l l g l t b t th  
 al th l l th l l t b æ p d l l  
 tl p t fl tl l l fl t b l O  
 f tl f th h ll l ul t m t fl l od l  
 l t d f the l q at ty f l t m t

block of the cord cannot be distinguished clinically from an anatomical overance the symptoms are identical—loss of all functions. If we wait to see if the cord will recover some function as it may after a physiological block we lose precious time and irreparable permanent injury may be done by the pressure alone. Consequently if these patients are to get relief at all they must have an early exploration. We all dislike to operate unnecessarily and have found the method suggested by Coleman some years ago of doing a spinal puncture and determining by jugular compression—the Queckenstedt test—if there is a block to be a diagnosis. If there should explore and do a block according to the probably useless to op

the lesion is a pulpifying of the cord for which operation can do no good. That is the principle I have been following in the past 18 months but it is not improbable that that is too conservative an attitude to take. Since we know that it is possible that the Queckenstedt test may not be positive in the presence of compression of the cord by a spinal tumor it seems perfectly logical to assume that the same thing may happen in the presence of a fracture—there may be compression of the cord and yet the Queckenstedt be negative. In such cases operation is indicated. No doubt the pendulum will swing back to a point where some of these cases will be operated upon. If the picture of a partial block is present operation should be done only if there is evidence of compression of the cord as shown by the Queckenstedt test. Then too operation should be done early before secondary degenerative change occur.

Abscesses of the cord or solitary tubercles present the picture of a focal spinal lesion and should be operated upon. I want to record a unique case that we had years ago in an infant age 6 months. The lower extremities were totally paralyzed and all reflexes abolished. The legs of the child were anesthetic but on account of the age of the child the upper level could not be determined. A lipiodol injection showed a complete block (Fig 1). At operation a swollen cord was found and when it was incised a brownish mass the size of a peanut was readily evacuated. I thought that it was a dermoid but section showed it to be a solitary tubercle. The child made an excellent recovery at the time and learned to walk but 18 months later died of pulmonary tuberculosis.

Meningitis due to a pyogenic organism is such a hopeless desperate disease that anything that may reduce the mortality which is close to 100 per cent is justifiable for that reason when we see such cases early we drain the lumbar region at the site of the third or fourth spinous processes. This operation was in recent years revived by Dr William Johnston and certainly deserves a trial. In we have used this method and there been 6 re That is a small per of rec ut in view of the fact

that it had not been done probably all of the patients would have died it seems worth trying Dandy has advocated drainage of the cisterna magna in preference to that of the lumbar drainage Where there is no spinal block between the cisterna and lumbar region I can see no advantage in draining at that point and with the marked retraction of frequently present in a case of meningitis the operation is technically more difficult and a more formidable procedure If there is a local focus from which the meningitis originated that of course should be drained just as the appendiceal abscess must be drained if a spreading peritonitis is to be controlled The two conditions however are not otherwise comparable for in the subarachnoid space there is a fluid which is being constantly secreted in large quantities while in the peritoneum the amount of fluid secreted is negligible In favorable cases of meningitis which ultimately recover I have seen the drainage continue for 6 to 8 weeks Repeated spinal puncture does not accomplish the same thing for between punctures the reaccumulating fluid tends to break up adhesion and spread over the cerebral cortex Several of my meningitis cases followed operations on the nasal sinuses by otolaryngologists but in such cases drainage of the local focus is quite impossible and of no avail In not all the cases of meningitis have organisms been found but in such cases the diagnosis was made on the clinical picture and the high cell count in the spinal fluid varying from 600 cells up to thousands Of the cases which resulted in recoveries cultures showed the proteus vulgaris in one the streptococcus in two and the staphylococcus aureus in one The question has been raised whether some of these cases in which organisms were not found might not have been sporadic cases of meningococcus meningitis As all fluids were cultured and studied microscopically and as in no case intracellular diplococci were found we feel that this possibility can be excluded

Occasionally we see cases of cord compression due to spinal deformity (Figs 3 4) I reported such a case before the American Orthopedic Association in 1923 In that paper



Figs 2 and 3 Spinal deformity which caused cord compression Photograph taken about 4 weeks after operation

it was pointed out that similar cases had probably been mistaken for compression due to a tuberculous lesion Recently McKenzie of Toronto has reported a similar case In his case as in mine the rapidity with which the patient recovered after the compression was relieved was extraordinary My patient had been totally paralyzed for 11 months and had been unable to move any muscles of his legs during all that time yet in 48 hours he began to move his legs and was walking 4 weeks after the operation Undoubtedly this condition is more common than would appear As a rule these cases are called tuberculosis and are not operated upon Just what the pathological condition is is uncertain I feel quite sure however that not the lipomatous mass overlying the cord (Fig 4) but the gibbus over which the cord is stretched is responsible for the symptoms





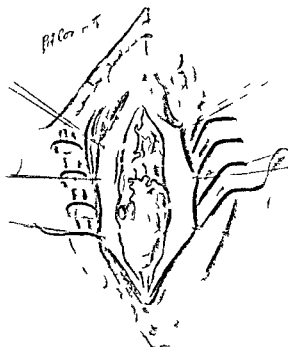
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Amples opportunity should be given a patient to recover under orthopedic measures from spinal cord compression in Lott's disease but if no improvement occurs after these methods have been given a fair trial operation may very properly be considered. Just how long the conservative methods should be tried is a matter about which there is considerable difference of opinion. I ever recently has advocated operating after 6 months if there has been no evidence of return of function. This seems a reasonable time to wait although cases are recorded in which recovery occurred after paralysis had been present for a far longer time. When operation is performed the spinal dura should not be opened if there is any evidence as there usually is of an extradural process on account of the danger of stirring up a tuberculous meningitis.

Spastic paraplegias without sensory disturbances have received much attention from the neurological surgeon. It is beyond the scope of this paper to go into the merits of the various operative procedures that have been used to relieve spasticity since I am discussing only spinal surgery. The various procedures may be grouped under four headings: (1) operations on the tendons (2) operations on the peripheral nerves (3) operations on the posterior roots—the Foerster

operation (4) the Royle operation on the sympathetic. Each of the first three has its place in selected cases. The fourth the Royle operation is useless in the treatment of spasticity. The section and removal of the sympathetic does not affect muscle tone sufficiently if at all to be of any practical value. Since this paper is on spinal surgery I shall speak only of the Foerster operation.

The so called Foerster operation the cutting of selected posterior roots intradurally changes a spastic leg to a flaccid one in a most remarkable and striking way. I have done the operation in about 30 cases but I have used it less frequently in recent years. I have learned that in the first place the after treatment—massage and re-educational exercise—is of enormous importance. If it is not carried out for a long time the improvement will not be maintained. Then too the after treatment need the intelligent co-operation of the patient and many of the patients are children who are mentally deficient if there is not enough mentality present to give one intelligent co-operation the operation should not be undertaken.



F b 5 T m f t l t l m t i l d t m l d  
 f th d

In selected cases it still remains a most helpful procedure. It is a formidable operation. The roots should be cut at their exits from the canal not at their origin from the cord. At the latter point it is impossible to identify the different roots and as Foerster originally pointed out it is very important to select the roots in such a way that each group of muscles will have some sensory supply left. Any operative procedure for spastic paraplegia however should not be undertaken until it has been determined what has caused the paraplegia for spastic paraplegia is only a symptom not a disease. Some years ago I removed an endothelioma from a girl who had been riding around in a wheel chair for 8 years with a diagnosis of spastic paraplegia. The tumor had not only compressed the cord but had eroded one part of the body of the vertebra so that a tongue like process extended into the posterior mediastinum. Its complete removal however brought no recovery in the legs as the cord had been permanently injured by prolonged compression. If no focal lesion can be found then the Foerster operation may be considered for the relief of spastic paraplegia.

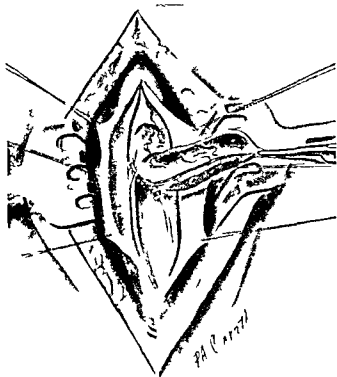


Fig 6 Shows the tumor after it was partially lifted out of its bed. Patient has had no return of symptom.

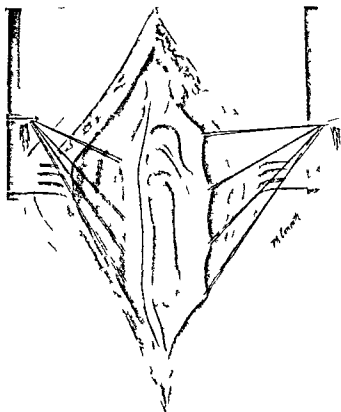


Fig 7 Type of vascular lesion in which one large vein compresses the cord. This was dissected out without much difficulty.

Of all the gratifying experiences in surgery I know of none greater than to make the paralyzed walk except perhaps to make the almost blind see. This is what we can do by removing spinal tumors in time. The vast majority of spinal tumors are benign encapsulated growths growing from the dura. They are either endotheliomata or fibromata. With care they may be removed so that no increase of the spinal symptoms occurs and though it is rare to have all traces of spinal symptoms disappear they clear up to such an extent that the patients are useful citizens with no appreciable discomfort or disability. There may be some increased reflexes or spasticity left or some sensory disturbance.

The localization of a tumor frequently offers considerable difficulty. It may be possible to determine the level from the sensory disturbances, the paralysis and disturbed reflexes. If by study of these one fails to establish the level the Queckenstedt test and finally an injection of lipiodol into the cisterna magna may be of great assistance. I have never had any help from spinal

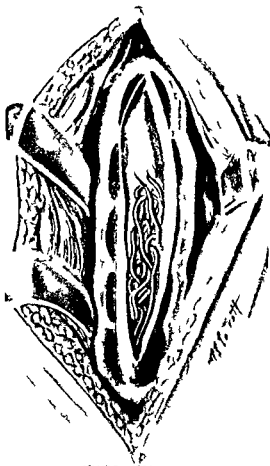


Fig. 5. Type of spinal cord lesion. The illustration shows a cross-section of the spinal cord with a central lesion. The letters and numbers are arranged in a grid-like pattern around the central image, likely indicating specific anatomical features or measurements.

our injection in the cistern. Lipiodol I use only when other method fail for there is no doubt Aver has shown that it is irritating though I have as yet seen no untoward symptom from it. Occasionally all these ignifol is occurred in an unusual case of tumor of the terminal portion of the cord possibly of the filum terminale. In this case the first and only complaint of the patient was inability to empty his bladder. He went to a genito-urinary surgeon who concluded that the bladder retention was due to a cord lesion. At operation we found the condition shown in Figures 5 and 6. This lesion did not obstruct the canal consequently both Queckenstedt and lipiodol tests were negative.

The illustration shows a cross-section of the spinal cord with a central lesion. The letters and numbers are arranged in a grid-like pattern around the central image, likely indicating specific anatomical features or measurements.

The treatment of intramedullary tumors is far less satisfactory since most of them are some form of glioma. Just what group these gliomas belong to remains to be seen. The new cytological method of Hortega which Dr Wilder enhanced and Dr Bailey have done so much to improve and apply to tumors will enable us to pick out those that are favorable from an operative standpoint as well as those that respond to X-ray treatment.

Where is the operation of laminectomy is far simpler than a cranial operation it should be emphasized that the spinal cord tolerate manipulation far less than does the brain. Slight trauma of the cord during an operation may cause permanent disability. Some years ago I was obliged to reoperate upon a patient who had become totally paralyzed immediately after an exploratory operation elsewhere for a supposed tumor. At the site of the old operation I found a traumatized contused cord and from what information I could gather I believe that the slipping from a rongeur caused this injury. The greatest gentleness must be used in the handling of the cord but of this and a few other technical matters I shall say a few words later on.

A certain group of cases presents the picture of a focal spinal lesion. Such patients are difficult to handle since they are entitled to an exploration yet at operation nothing can be done. Two years ago I reported a series of 33 such cases. Every diagnostic method should be used to cut this number down as low as possible but where a localized lesion is demonstrated by lipiodol or the Queckenstedt test an exploratory operation must be done to determine the nature of the lesion. In some of these patients the lesions are due to old inflammatory processes which have left adhesions which constrict the cord but in other cases no gross pathological lesion is found and the result of exploration is entirely negative.

Among the group of spinal tumor blood vessel tumor may be encountered which present atypical symptom and extremely difficult operative problems (Figs 7 and 8). They deserve special mention because their symptoms are unlike those of a solid tumor and resemble those of the series just referred

to—the arachnoiditis cases. Some of them are composed of a mass of thin walled vessels that cannot be removed by any of our present methods though it may be possible in future to deal with them by electrosurgical methods<sup>1</sup>

An entirely different group of patients that the neurosurgeon can do something for are those with intractable pain sometimes due to a malignant metastasis sometimes to tubercles and sometimes to no detectable cause. For these cases chordotomy, the so called Spiller Frazier operation may be a great comfort. It consists in the cutting on each side of the spinal cord of the anterolateral column which carries the pain fibers. The operation should be done high in the dorsal cord so as to catch the pain fibers well above the site of pain. When this is properly done the patient loses all sensation to pain below a certain level but retains normal touch and temperature sense. In a patient with a malignant metastasis to the spine the relief may be complete and this obviates the use of opiates but it is only fair to say that chordotomy does not always give complete relief. Whether this is due to a failure to get all the pain fibers or due to some other cause I do not know but not all the cases have yielded uniform results. To what extent the operation is applicable to patients with tabetic pains is also uncertain for some have complete relief and others seem to have little or none. The operation has to be carried out with great care for under the anterolateral column lies the crossed pyramidal tract. If the incision is too deep a motor paralysis may be produced while if incision is not deep enough the pain may continue. The tract that is cut is about 2.5 millimeters long and 2 millimeters deep (Fig. 9)

The last group of cases which the general surgeon is frequently called upon to take care of consists of patients with congenital defects—various types of spina bifida. If unruptured and there is evidence of some nerve fibers passing into the lower extremities or some rectal control the patient should be operated upon at an early age. A considerable percentage develop hydrocephalus. It is true but

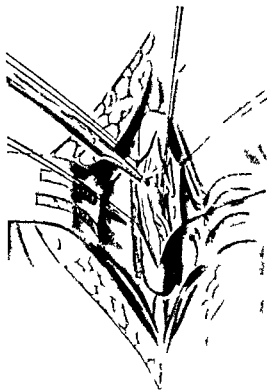


Fig. 9 This shows the way in which the dorsal root may be rotated by grasping it at a point where it is cut in a chordotomy.

I know of no way of determining which patients will do better. The possibility of hydrocephalus is a discouraging chapter. It is usually simple but the dura after the hernial sac is reduced and to close the defect a flap taken from one or both sides is necessary. I have never used a bone graft as has been suggested. In fact I believe giving a child is at least a vegetation is done but this is true though it is true many if left alone and only a few survive some of the children the sake of those few resorted to early

#### TECHNIQUE

As regards the laminectomy a few

The last group of cases which the general surgeon is frequently called upon to take care of consists of patients with congenital defects—various types of spina bifida. If unruptured and there is evidence of some nerve fibers passing into the lower extremities or some rectal control the patient should be operated upon at an early age. A considerable percentage develop hydrocephalus. It is true but

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always make a median line incision and carry it down to the spinous processes then with great care the periosteum is stripped from the spinous processes so as not to injure the muscles. With this technique extremely little bleeding is encountered. The entire spinous process is removed down to the articulating processes on each side. There is some difference of opinion about this. Taylor advocates unilateral laminectomy in order to keep the spinal column stronger. Myler does not remove the spinous process.

Taylor has recently described a number of cases in which cervical laminectomy was done and the patient suffered a forward dislocation. This should certainly be kept in mind as a possible complication. Whether this has occurred in my series of over 150 laminectomies I do not know. For Taylor points out it may occur without symptom and only a lateral X ray picture will reveal it. I know of no patient who has had symptoms which might be ascribed to such a complication and am inclined to think that a very careful layer closure may prevent its occurrence.

After the canal is opened great care must be exercised not to injure the cord by pressure or sponging or getting blood into the subdural or subarachnoid space. No gauze sponges are ever allowed at this stage only the finest

quality of cotton and with the judicious use of suction the cord is gently handled. If it becomes necessary to work in front of the cord or on one side the cord should be handled only by means of the ligamentum denticulatum to retract the cord with a retractor is never permissible—that is quite enough to cause a paralysis below that point. In order to do a chordotomy the cord has to be rotated over 90 degrees. This can be done by taking hold of the ligamentum denticulatum on each side. No clamps are ever to be applied to the cord. A bleeding point as a rule can be controlled with hot cotton and the application of a bit of muscle. Occasionally a silver clip may be necessary to control a vessel. This is much less harmful than the putting on of a clamp and then the tying of the vessel. If an endothelioma is encountered the dural portion from which it grows must always be excised as otherwise there is likely to be a recurrence. If a large piece of dura is removed a fascial transplant may be necessary to close the defect and prevent any cerebrospinal leak but with a careful layer closure of muscles deep and superficial fascia a dural leak need never occur. A heavy gauze pad and binder is all these patients need for a dressing. The old idea of a plaster dressing or plaster bed is totally unnecessary.

# A CLINICAL AND PATHOLOGICAL STUDY OF TWO TERATOMATOUS CYSTS OF THE SPINAL CORD, CONTAINING MUCUS AND CILIATED CELLS

By LAWRENCE S. KUBIE, M.D. and J. F. FULTON, M.D. BOSTON  
F mth S g l Clu f D H n y C hung P t B t Bngh m H p t l d fth Ch ld H p t l

THE two cases which we are about to report present features which both from clinical and pathological stand points are interesting and puzzling. We propose therefore to record both aspects of the cases in some detail. It is perhaps worthy of note at the outset that in each patient symptoms appeared first at the age of 2 years but the second patient did not come to operation until 5 years after the onset of her trouble.

*Case 1<sup>1</sup>. Children's Hosp. No. 10533. A cyst arising from the dorsolateral surface of the upper lumbar cord was associated with occult spina bifida and suddenly produced symptoms of cord compression in a boy 1.20 years of age. The cyst contained ciliated cells and mucus. Dorsolumbar laminectomy extirpation of cyst recovery.*

D. S., an Irish boy, aged 2 years and 6 months was first admitted to the Orthopaedic Clinic of the Children's Hospital, Boston, May 21, 1927, discharged 1 month later and again admitted for further observation on July 2, 1927. His family history contained nothing relevant to his condition. In his own past history, the only important fact was that he had always walked with a slight dragging limp of the right leg. He was admitted for the first time because he had recently been fretful and for several weeks had stopped eating and lost weight.

The child cried almost constantly in apparent pain. His back was rigid with intense spasm of the lower spinal muscles and he stood up only with the greatest reluctance. When lying on his back he held his legs partially fixed and his pain seemed to be greater upon passive motion of the limbs, especially at the left hip. The clinical suggestion of tuberculous of the bone was not borne out on repeated X-ray examination and repeated tuberculin tests. The roentgenogram revealed however a spina bifida occulta with incomplete fusion of the lower thoracic lumbar and sacral vertebrae, most marked in the first, second and third lumbar arches. Neurological study revealed hyperactive deep reflexes in both lower limbs but especially on the right; there was also a poorly sustained ankle clonus and a positive Babinski on the right. In the course of a few weeks he seemed to lose whatever sphincter control

he had previously possessed and then developed an apparent zone of hyperesthesia at the level of the umbilicus.

**Lumbar punctures.** On June 13 a lumbar puncture yielded fluid that was contaminated with a small amount of fresh blood (presumably a bloody tap). The pressure under anesthesia was normal and the response to jugular compression showed that there was no block. Six weeks later however on July 9 a pale yellow fluid was obtained at a second lumbar puncture containing two cells and a 4 plus 1andy. The fluid failed to clot on standing. On this occasion the cerebrospinal fluid pressure varied between 0 and 10 millimeters of fluid and there seemed to be little or no increase in the pressure on compression of the jugular veins. In 6 weeks therefore a condition of at least partial block had developed and a xanthochromic non clotting fluid had appeared below the level of the suspected obstruction. (It is possible but not likely that the color was due to blood introduced at the previous puncture.)

Three days later a combined cistern and lumbar puncture was done. The cerebrospinal fluid from the cisterna magna was normal and under normal pressure. From the lumbar region however at a level one interspace above that of the earlier punctures an entirely novel fluid was obtained. This fluid was so viscous that it had to be aspirated with a syringe. It was in the main quite clear and colorless with a few cloudy streaks running through it. In appearance and in physical characteristics it was exactly like the white of a raw egg. In it were found 2700 cells which were incorrectly reported (from a counting chamber analysis) as lymphocytes. No pressure measurements could be made upon this viscous fluid. On August 3 an injection of lipiodol was made into the cisterna magna under ether anesthesia. Although the main mass remained above the level of the ninth dorsal vertebra scattered droplets of lipiodol descended to the caudal tip of the dural sac. In the head down position the oil droplets which had previously slipped down past the dorsal level collected at a point below the partial obstruction without repassing it.

On August 5 therefore two diagnostic punctures were made: one at the level of the tenth dorsal interspace and the second at the fourth lumbar. The upper puncture again secured a sample of the gelatinous mucoid fluid. The cells of this fluid were examined by the supravital technique of Sabin (5) and were found to be predominantly large round granular mononuclear ciliated cells (Fig. 1) with a

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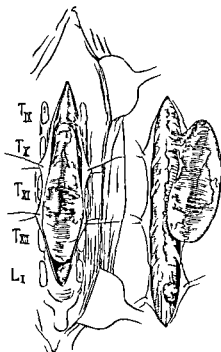


Fig. 1. h. d. d. f. l. t. d. l. f. m. th.  
p. t. l. p. t. f. m. c. d. f. d. f. m. th. y. t.  
L. h. l. u. m. c. l. d. b. e. s. e. t. f. m. l. f. t. l.  
g. a. l. d. t. t. r. m. t. t. h. f. l. m. l.  
g. a. l. e. Th. d. e. s. q. m. t. l. l. w. g. r. a. l. a. d.  
d. n. t. l. y. d. g. n. e. r. a. t. N. c. l. y. m. m. t. w. s. e.  
t. h. e. t. k. f. m. C. b. y. l. m. b. a. p. t. e.

few polymorphonuclear neutrophilic leucocytes a few lymphocytes and a few red blood cells. The puncture at the lower interpace revealed a clear fluid with a normal count and a firm though slightly sluggish response to jugular compression. It seemed evident the effort that the intracranial of the viscous fluid at the upper level had lessened the obstruction in the subarachnoid space thereby diminishing the block and luminating the previously observed xanthochromia. Just before the operation on August 11 the punctures of August 5 were repeated with similar findings. Chemical examination of the viscous fluid showed it to contain large amounts of mucous material a total protein of 657 milligrams per 100 cubic centimeters while the cerebrospinal fluid from below the lesion had lots of xanthochromic tint gave a negative Wassermann

TABLE I—SUMMARY OF LUMBAR PUNCTURE FINDINGS IN CASE I

D	Le	Fl	P	J. C. m. p. es
July 9	L	l. h. l. blood P. l. y. l. d. p. (P. d.)	N. m. l.	N. m. l.
Aug 1	Coml. sl	N. m. l. f. l. ed. asc. I. les. y. l. k. h. f. 700 ll f.	N. m. m. Too f.	N. m. l.
Aug 1	I. p. e. l. l.	P. l. l. b. f.		
Aug 5	L. s.	Cl. l. l. t. m. l.	N. m. l.	l. h. l. p. se
	D.	E. h. f. l. d. C. l. l. be. l. u. d.		
Aug 11	L. s.	(F. p. e. ) t. b. l. j. N. be. f. p. l. gh. ly. s. m. g. m. / 100 m. As b. T. l. p. m.		
	D.	6 m. g. m. / 100 m.		



F. k. T. m. f. C. s. A. A. n. t. p. e. t. m. m.  
d. t. l. y. f. t. g. t. h. d. B. S. D. w. t. r. u. c. t. e. d.  
t. p. e. d. c. l. o. f. t. m. d. h. t. f. a. t. t. h. m. t. t. h.  
d. (F. m. D. H. k. t. h. m. d. m. m. d. t. l. y. a. f. t.  
p. t. )

t. st. a. neg. t. i. gold. sol. u. and contained 57 milligrams sugar 717 milligrams sodium chloride and 5 milligrams of total protein per 100 cubic centimeters. In short the fluid below the level of the lesion was normal but for a very light increase in the total proteins. A summary of lumbar puncture findings is given in Table I.

The fact brought out by this series of studies may be summarized as follows: (1) Rapid development of spinal block and xanthochromia in the lumbar fluid in the interval between punctures 1 and 2. (2) Partial removal of the block and disappearance of the xanthochromia very rapidly after a high rupture which obtained the white egg white fluid (cerebrospinal fluid) (3) Demonstration of a level of partial obstruction at the ninth dorsal vertebra by the (4) Repeated removal of a white fluid from the upper lumbar region which contained ciliated cells and cilia.

**Operation.** Operation was done August 1 by Drs. Gilbert Horrax and Tracy Jackson Putnam. Laminectomy disclosed within the subarachnoid space a silvery gray shimmering cyst nearly 6 centimeters long and 1.5 centimeters in diameter which was then in cystic fluid. A dose of the cord from the level of the ninth dorsal to the first lumbar vertebra. A drawing made from Dr. Horrax's excellent operative sketch is given in Figure 2. On aspiration the contents of this cyst into a



Fig. 3 Ciliated epithelium from the lining of the cyst in Case 1, No. 375. Stained in hematoxylin-eosin after Zenker fixation and mordanting in Regaud's solution. The cell borders, basement membrane, and at some points the granules on the cilia are clearly brought out.



Fig. 4 Thickened area of the cyst wall from Case 1, No. 375. Zenker hematoxylin-eosin. The dilated vascular channel and the mucous and serous glands are seen in their relation to the epithelium.

syringe it was found to contain both the viscous mucoid fluid and the ciliated cells which had already been obtained at lumbar puncture. Over the delicate surface of the cyst were fine blood vessels which gathered together at the level of the ninth dorsal spine into a fine and apparently solid stalk. Through this stalk the cyst seemed to grow out of the right dorsolateral surface of the spinal cord, approximately out of the tip of the dorsal horn of the grey matter.<sup>1</sup> This vascular stalk was clipped with two silver clips and severed in between them. The sac was promptly removed and fixed in Zenker's fluid. No central channel could be made out through the stump of the stalk. The cord beneath where the cyst had pressed against it was slightly flattened. At the lower end of the cord, just above the cauda equina, there was imbedded in the right side a hard nodule about the size of a pea. This was left untouched.

**Histological appearance.** The sections were stained in hematoxylin-eosin, carmalum, phosphotungstic acid, hematoxylin (Mallory), and after secondary mordanting in Regaud's solution unsuccessful at attempts to secure mitochondria stains were made with acid fuchsin, methyl green (Cowdry).

The greater part of the cyst wall was of almost paper thinness and at only one point was there palpable thickening. Sectioning of the cyst showed that the thin membranous wall consisted of a capsule of connective tissue and blood vessels which was lined by a layer of epithelium. The epithelial layer was composed of cells which varied in structure from low cuboidal to high columnar and in places patches of uncovered connective tissue could

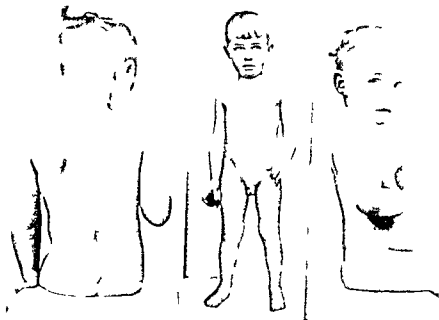
be seen denuded of their epithelial layer. The area of thickening in the wall however presented a picture of surprising complexity. Here the epithelium was made up of tall columnar cells in pseudo stratified layers. The cells were ciliated at their free border and lengthened out to form long tails which pointed centrifugally toward a fairly well defined basement membrane (Fig. 3). Below this were found abundant blood vessel, connective tissue and actively secreting mucous and serous glands (Fig. 4). There were in addition some interstitial hemorrhages (which might conceivably have been induced at the operation) and polymorphonuclear leucocytes were scattered sparingly throughout the tissue without any point of great concentration suggesting a subacute inflammatory process. Smooth muscle was also present. A few large myelinated nerve fibers were seen but there were no nerve cells or glial elements.

**Postoperative course.**—The postoperative course of the child in the hospital was uneventful. Within a few days he had ceased his previously incessant crying and was a little less alarmed when approached. The hyperesthetic zone over the abdomen and thighs was gone, control of the sphincters returned and the reflex changes became much less clear cut. He was sent to a convalescent nursing home on August 6.

The child was last examined on February 11, 1928. At this time he ran around the examining room without apparent disability. No knee jerk could be obtained on the left side and on the right only a feeble and inconstant response. The ankle jerks on the other hand were active and again the right side was more active than the left. The cremasteric reflexes were present on both sides but sluggish on the right. The abdominal reflexes were absent in

<sup>1</sup> It is possible that the stalk of the cyst was the site of the original tumor. The stalk was found to be composed of connective tissue and blood vessels which were lined by a layer of epithelium. The epithelial layer was composed of cells which varied in structure from low cuboidal to high columnar and in places patches of uncovered connective tissue could be seen denuded of their epithelial layer. The area of thickening in the wall however presented a picture of surprising complexity. Here the epithelium was made up of tall columnar cells in pseudo stratified layers. The cells were ciliated at their free border and lengthened out to form long tails which pointed centrifugally toward a fairly well defined basement membrane (Fig. 3). Below this were found abundant blood vessel, connective tissue and actively secreting mucous and serous glands (Fig. 4). There were in addition some interstitial hemorrhages (which might conceivably have been induced at the operation) and polymorphonuclear leucocytes were scattered sparingly throughout the tissue without any point of great concentration suggesting a subacute inflammatory process. Smooth muscle was also present. A few large myelinated nerve fibers were seen but there were no nerve cells or glial elements.





A B C  
F I h t g ph f i t p t t m th ft pe t h A R  
g f l m t m y t l f f h h l f t h t p  
b t d B J C N m l p t f p t t t p t

the lo er quad ant but fe bly r J n i t  
the left upp quad ant Th B bi k r p n s  
we c in lete min t on th right th g t t t n l  
up the f t t n l i v l n l th r t i a p r l  
slightly to the th t usu lly th light fl u n  
the respon eo the l f t l a f th m n tur  
but less markel M a i r ment sho d th l f t l g to  
be 4 to f a n i h m a l l r n r c u m f c n th n  
th ght The ablo min l m u s l s r str ng th  
chill itting up ght fr m th pro e p i t i n ith  
ut luff c lty No n o r y l i s i c l t e s o u l l b m a l  
out

It could not b d e t e m i n d w h t h t h e r f l e x  
d s o r d r s b s d c r d l f m t h p r u r  
w h i c h t h c y s t h a d t l h t h t h c l u  
to th n j u l e h h h l b n e n t b e r t h  
l y n g i t h r i g h t d o f t h r d j u t l o e t h e  
c a u l a q n a

Case P B B H S i g V o 961 R u n t  
i t t c k s f l u a i d q i d r p l e g i t 9 1 a n l  
(t h e p r s e t) t v r r a s i t d u l l p u b a c k  
f k d B u S e q u i d d s c i t n f s i i t i  
t e b o d y E i g e 3 e t l l i t o m y u l l  
r e o i l f l i d s l a t e l c d c y t a t l i d c l  
c t a i r g c d l i t d c l l R p d r c y f  
p u i d s t

K J n m d l n i s t n o g a f h o f 7  
y e a r w a d m i t t d t h u o l o g l s c o f  
t h e l t B t B g h a m H o s p t l o n S e p t m b e r 8  
19 7 a s p n a l c o r d t m o r u s p t n t h e c o m

W w h  
p e m i n g p o b g d I H y c h g f

m n l a t i n f D r J E W h t f M a l n N Y o k  
a n d D L V B l r a u o f S y r u s N e Y k  
b c a o f p r e s i n l u m b n o f h e x t r e m i t e s  
Th n h i t r f a n y i m l a r o n d i t i o n o c c u r  
r i g i n t h p a t i n t s f a m i l y

The pat nt had t n t o l d b y h r m o t h e r t h a t a t  
t h e a g f a b u t r s h e h l h a d a c o n u l  
s o a f t e r h i c h h l o s t c o m p l e t e l y t h e s e f i e r  
a m a n l l g o n t h e l f t s i d T h e c o n l i t n d e l o p e d  
d d l y l a s t e l a b u t 5 w e e k s a n l d i a p p e a l  
a p i d l y a p p a r t l y l a n g r s i u a l l e f e c t s

A t h a g f 8 h e h l a p e r i o d o f s l i g h t c a k e s  
o f h e r l f t i e l e t a n g n l v l s b u t a y e a r l i t e r  
h e h a d a m r e s e u e d n g h i s h e n t  
t t h R o a l V t a H p i t a l M o n t a l (A u g u t  
3 900) f r b s r t o T h u g h t h o r t e s o f  
t h s s t i t u t i o n v e h a s e e n t h e c e l l t h s t o r y  
m a d e a t t h a t t m T h p t i t f a t h r t a t e l t h a t  
7 e c k s b f o a l m n h h l b n t a k n i t h

p a i n i n t h l f t l e o f h r n k s p e a l l y  
o t h e u p p r t h e v a l e r t e b r e a n d f e  
d a v s l a t e t h l e f t m a d l e g b c a m a l m o t p r l  
l T h e f a t h e r h d o b v e d a e e k a f t r t h e o n t  
t h t h e c h i l s l f t v l d d o o p l t h a t t h l f t  
p u p l h i b c o m s m a l l t h a n t h e r i g h t a n d t h a t  
t h e r e a p p a l t l a l i g h t i n t l q u t (l f t)  
S h a l h a l h a l m k d t h o p n e r F m i n t n  
n n t v s h l t h t h e g h t p u p i l t i l l r g  
t h n t h e l f t a n l t h t h v a v l f t p t o s  
( p h t h a l m ) O s o n a l l y t h l i t v e d  
d e p p i r t n a s s p a o y s m o f p i n l e f t  
s h u l d h n p t e n t i s p u t i n l e v l

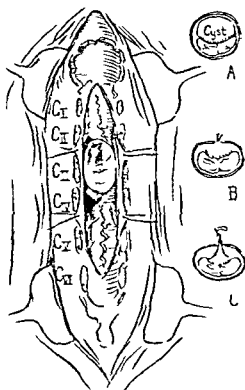


FIG. 6. Operative field in Case 1, redrawn from Dr. Cushing's immediate post-operative sketch, showing appearance and approximate position of the lesion. Also A, a transverse sketch of the cyst *in situ* showing the compression of the spinal cord beneath it. B, The closure of dura over remaining adherent portion of cyst. C, What according to operator would presumably have been a more effective way of dealing with lesion in view of its possible future redevelopment.

position in bed she immediately became dyspnoeic and cried out that she was suffocating. There was marked pain when an attempt was made to bend her head backward. It was observed also that her left arm and hand were smaller than her right (glove measurement 1 centimeter right 16 centimeter left also 1 centimeter difference in diameter and in length of arms no difference in legs) and there appeared to be wasting of the flexor muscles of the left arm and of the left hypothenar eminence. The deep reflexes on the left were markedly increased and there was persistent patellar and ankle clonus. While she was under observation her condition rapidly improved and she was discharged on September 9, 1909, with a tentative diagnosis of hysteria. Improvement continued and 3 to 4 months from the onset of the attack he was again perfectly well.

At the age of 1 the same thing once more occurred. Again the symptom began with stiffness of the neck, followed closely by pain in the left side of the neck and in the left shoulder and finally by a gradual development of paralysis. The weakness appeared first on the left side but in this attack the palsy was also spread to the right until in the end paralysis and numbness extended all over her

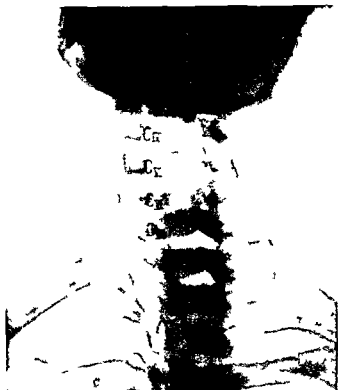


FIG. 7. Case 1. X-ray pictures of cervical region after operation. Note the slight widening of upper cervical canal. In this film the position of the silver clip shows the exact level of attachment of the cyst to the spinal cord. The approximate size of the cyst is indicated by dots. The spinous processes and laminae are missing from the second to the sixth inclusive.

trunk and four extremities. During this attack the patient again suffered agonizing pain in her neck and shoulder. The paralysis was not absolute—enough voluntary power remaining to enable the patient to work herself around in bed. There were no sphincter difficulties. Recovery again set in with great rapidity and this time it was initiated by a sudden sensation that something had happened in the back of the neck. Within a few days after this sensation occurred practically all of the symptoms had disappeared. At no time had there been any headache, fever, diplopia, or other cranial nerve disturbance and no convulsions or other manifestations of forebrain pathology. After this attack the patient's left hand remained permanently weak and never developed as completely as the right. However, during the 15 years which intervened between this attack and her present seizure it was useful in her occupation of stenography, was but little impaired. Almost every summer since this attack the patient suffered from short periods of stiffness of her neck and some numbness and pain and occasionally some muscular weakness in her left arm. These abortive attacks always passed off however with rest in bed.

**Present attack.** On August 1, 1924, the present attack developed. The sequence in which the symptoms appeared was almost exactly that of the



a

F s Th t f m c l k f t g Ap  
p m t l v t l th h l k f t th f t l  
l t l p s t t l d t l l f t h y t  
s d l l y h k

earl ratta ks stiff e k p n n th sho ller v ak  
fr t th l f t l f l l b y p r a l t the  
right numb fir t on th right l l f l l e w l b y  
p r a l t th l f t I thi lition the p t i e n t was  
brought t th ho pital

A u l g l l t t u s p t o p t u n (Thi s a  
summ v f r p r t e l e x a m i n a t n s m a d e d u r i n g t h  
4 hours that th pati t a i n th ho p i t l b e f o r  
an emerg n o p a t o n v a p e r f r m d o w i n g t o  
th o n c t f n e r a s i n g l y l a b o r d e s p r a t i o n )

Spontan ous pain and po t u c l r m p r f r e n c e  
the pati t h l d h r h i n f o a r l i l i o n A n  
m o t o n f r o m t h i s p o s t o n s p e c i a l l y a n y t u r n g o f  
t h a l c u s l x e r u t g p a i n h h r a d i r t l u p  
the back of th e c k t o t h o c p u t a n d d o n t h e  
should r s e c z i n g g h r g l e p r e s u r e  
n the jugular i n p e i t a t d m l a a t t a c k o f  
a g o n i s t p a i n l h c l o r c e c a l v r t b a e  
u t e l y t n a i n e

Respiration Th b e a t h i n g a s c l v l d a  
p h r a g m t i c t h n o p a r t i c i p a t i o n f t h e n t r c t a l  
m u c l e s D u r n g t h 4 h u f o l s e r a t i o n t h  
b r a t h i n g b c a m g a s p g l l b o r d

C a n t l n l h c r s e n t i a l l n i n o l d  
n the p Th r c a s m o d e r a t p a i e o g  
t i o n o f t h e f u n d i w i t h o u t l a t i f t h e l s c  
o b s e r a t i o n o f t h r m a r g i n s T h f a c t t h t h e l f t  
v e l d d o p e d l t h t t h e l e f t p u p l a s s m a l l  
t h a n t h e r i g h t u g g t e l p c u e o n t h e l f t c v  
c a l c o r d T h l e f t s d o f t h e f a c e w a s m o e s l u h e d  
t h a t h r i g h t

M t o p o e r T h e r e v a s l m s t o m p l t o l o s  
o f o l u n t a r y m o t i o n n a l l f o u e x t e m t t h e l f t  
a m a n d l e g p s r v i n g a l t t l e m o r e f m o t i o n  
t h a n t h e r i g h t b u t t h e a c t n i t i o a i l f r o m  
h o u r t o h o u D s p i t e t h f t t h a t t h l f t a r m  
a s s l i g h t l i n o l d t h t i m e t h e a r l e  
a t t a c k s h a d l e f t t h i s a r m a n d h a n d m a r k e d l y s m l l e  
t h a n t h e r i g h t g l o m e a s u r e m e n t s s h g t h  
r i g h t 3 c e n t i m e t e r s l a r g e r t h a t h e l f t ( t h e a g o f  
9 t h d i f f e r e n c e a s n l y c e n t i m e t e r s ) T h s  
d i f f e r e n c e s e e m e d t o b e d u e m o r e t o u n f o r m f a i l u e  
o f d e v e l o p m e n t o f a l l o f t h e m u s c l e s a n d b n e s o f  
t h e l e f t u p p e r t r e m t y t h a n t d e v e l o p m e n t a l  
f a i l u o f a n y s p e c i a l m u s c l e g o u p T h l f t a r m



I o s t o f t h y t w l l f o m C  
l r m l / k m d t H a d l Th p t h e l  
l v l d f m o o t h m s c l d l t d b l o o d s e l s  
l y m p h d l s c a t t d g l a d e l l b l

a n d h n d l a y i n p r t i a l f l x o r s p a s m m u c h o f t h  
t i m e I t c o l d b v a k l y f l e d a t t h e e l b o a d  
s o m l u t a r y m o t n o f t h e f i n g r a s p o s s i b l e  
T h e g h t w a s f l a c e d a n l m o t i o n l e s s T h e p a t i e n t  
c u l d f l v b o t h l g v e k l y a t t h h i p s a n d k n e e  
t h l f t m o e t h a n t h e r i g h t a n d w h i l e f r e m o t i o n  
o f t h l e f t t o s a s p o s s i b l e n o n a s p s e n t o n  
t h e g h t s i d A t t h e t i m e o f e a m i a t i o t h e r  
f r a l t h o u g h t h p a r a l y s i s h a d b e g u n o n t h e l e f t  
i d i t h a l b e c o m e m r e p r o f o u n d o n t h e r i g h t

D p f l x e a n d l n u s A l l o f t h d e e p r e f l e x  
m a k e d l y h y p e a c t i e C l o n i c p h e n o m e n a w e e  
c l e c t e d i n b t h r m s a d i n t h f i g r s o f b o t h  
h n d b u t s p e c i a l l y o n t h e l e f t I n b o t h l o e r  
e x t r m t i s g l u t e a l p a t e l l a r a n d a k l e c l o u s c o u l d  
b e l e c t i b t t h u s e r m o e s u s t a e d o n t h e  
l f t t h a n o n t h e r i g h t d T h e c l o n c r e s p o n s e  
v e r e r a l i l y n h i b i t d b y p i n c h g t h e k o f t h e  
l i m b i n w h i c h t h e y e o c c u r n g T h e r i g h t s i d e  
v a s m o r f l a c d t h e l e f t m o e s p a s t i c

S u p r f i c i a l n l a s c a t d r e f l e x e s A b d m i n a l r e  
f l e x e s r a b s e n t G e n t l s t i m u l a t i o n o f t h s o l e o f  
t h e f o o t p r o d u c e d i n t e n s e l y a c t i v e p o s i t i v e B a b i n s k i  
r e s p o n s a s d t h i d e s p r e a d f t h e s e n s i t i v e z o n

a s e v i d n e e d b y t h e p e s e n c e o f p o s i t i v e C h a d d o c k  
O p p e n h e i m a n d G o d n p h n o m e n a A a r e t y o f  
u n t r o l l a b l a s s o c i a t e d r e f l x p h e n o m a c o u l d  
b e p d u c d b y s l g h t s t i m u l a t i o n f t h e s k n e g  
p a c h g e s p l l y o n t h e l e f t s i d b t a l o n t h  
r i g h t O f s u c h a n t u r w a s t h e i n h i b i t i o n f c l o u s  
b y g e n t l p n c h i n g o f t h a c t v e l i m b M v i g o r

u s p n c h i n g f t h l o e r t r e m t y c a u d m a r k e d  
u p l t e r a l f l r s p a s m ( d e f n v e r f l e x ) w t h  
c o t l t r a l e t s i o t ( P h l l i p s o n r e f l e ) a d s i m  
l a r s t i m u l a t o n o f t h e u p p e r l i m b c a s e d u p s i l a t e r a l



Fig. 10. Another area of the cyst wall of Case 1.  $\times 75$ . Formalin Zenker mordant hematoxylin eosin. Here the epithelium is seen to form deep branching invaginations through the layer of smooth muscle and lymphoid infiltration. Still deeper are seen mucous and serous glands, fat cells, etc.

extensor spasm of the arm with flexion of the hand and sometimes a spread of the response to include flexion of the ipsilateral leg with contralateral extension. It is perhaps significant that there was spreading of these involuntary associated reflexes from the upper extremities to the lower, but *not vice versa*. There were also frequent attacks of spontaneous uncontrollable movements from time to time occurring possibly on the basis of accidental skin stimulation. Sudden violent extension of the arms with flexion of the fingers at the proximal joints was especially frequent.

**Objective sensory disturbances.** All disturbances of sensation were found below a line which ran from the top of the acromion on the shoulders to a point 2 inches below the episternal notch on the sternum, corresponding roughly to the lower limits of the sensory distribution of the third and fourth cervicals. Below this level she presented a more or less typical Brown Sequard sensory dissociation. Heat, cold, and pain were grossly impaired all over the right side below this level, but were less impaired on the left, whereas position sense was only partly impaired on the right side but was more grossly affected on the left.

**Minor symptoms.** The patient had suffered from chronic constipation for some time and for 2 days



Fig. 11. A clump of cells which resemble ganglion cells from deep in the cyst wall of Case 2.  $\times 650$ . Formalin Zenker mordant hematoxylin eosin.

had had urinary retention so that catheterization was necessary on admission. The skin showed excessive dermatographism and even gentle pinching caused a rapid development of subcutaneous ecchymoses. The patient was extremely obese. The left side of the body was warmer than the right.

**Summary.** A young woman, 27 years of age, had had recurrent attacks of paresis of extremities with subjective sense of numbness in trunk and limbs. On admission to the hospital she had almost complete paralysis of all four extremities and of the intercostal muscles, with extreme hyperactivity of reflexes, the greater reflex hyperexcitability being on the left side, the greater loss of voluntary motion on the right. She suffered from constipation, urinary retention, and vasomotor skin disturbances (i.e., dermatographism, ecchymoses, and uneven distribution of skin temperature). Root pains extended up the back of the neck and down the shoulders and were intensified by coughing, sneezing, or compression of the jugular veins. Below the level of sensory distribution of the fourth cervical nerve, there was marked diminution of all cutaneous sensation—with a tendency to a Brown Sequard dissociation—i.e., with pain, temperature, and light touch more involved on the right and paralysis and position sense more involved on the left.

**Impression.** Compression of the cord at the level of fourth cervical, most marked on the left side. With the recent experience of Case 1 in mind, the suggestion was ventured that this might prove to be a similar congenital cyst, either with or without association with spina bifida.

**Pre-operative course.** On the afternoon of September 9, the day following admission, the patient was taken to the X-ray room to have films made of her



thought ought to have been done with it (Fig 6 C) to lessen the likelihood of recurrence is given here with The cyst was fixed in formalin

*Histological examination* This cyst was relatively heavy walled (Fig 8) varying between 1 millimeter and 2 millimeters in thickness Viewed from the inside it was seen to be split by ridges and grooves into an irregular cavity At one point however the wall reached a thickness of nearly 3 millimeters Sections were cut through several regions and stained as in Case 1 As in the other cyst the thinner areas were relatively simple toward the lumen was an epithelial layer consisting of low cuboidal to high columnar cells Outside this lay not only connective tissue but also long flat bands of smooth muscle (Fig 9) On nearing the thickened zone groups of glands were seen (Fig 10) and complex branching invaginations of the epithelium (Fig 10) Finally in the widest area were great masses of lymphoid tissue (Fig 9) abundant smooth muscle bands (Figs 9 and 10) many blood vessels some cartilage (Fig 12) and—as in the other—quite extensive interstitial hemorrhages with some evidence of acute inflammation Many small bundles of myelinated nerve fibers were found and in one area large round cells which resemble nerve cells (Fig 7) but since special stains for tigroid substance and neurofibrillæ were not made because of the fixation their positive identification is open to doubt Next to the lumen of the cyst was an epithelial layer of pseudo stratified columnar cells with cilia and pointed tails leading centrifugally toward a basement membrane (Fig 13) In the connective tissue near the meningeal surface were occasional solidly calcified blood vessels forming typical psammoma bodies

*Postoperative course* An immediate and dramatic return of function began even before the patient was removed from the operating table Voluntary flexion and extension could be performed weakly at both wrists there was free movement of the fingers flexion and extension of the ankles flexion of the knees and a beginning return to thoracic respiration

During the succeeding 4 hours the improvement went on hour by hour Full participation of the intercostal muscles in the movements of respiration recurred Micturition was possible Voluntary movements of the extremities became increasingly free with the greater improvement taking place first on the left side and in the distal joints of the limbs The overactivity of the deep reflexes diminished the clonus phenomena were lessened and the abnormal responses to cutaneous stimuli underwent a similar change Sensation on the whole returned more slowly than motor functions There was however some improvement in sensation within the first 24 hours and this brought into clearer relief the difference which had been observed before the operation between the distribution of the defective cutaneous and deep sensations Thus the perception of all cutaneous stimuli (touch pain and temperature) improved markedly on the left side

but not on the right while the recognition of passive movement of the limbs became more accurate on right side but remained wholly impossible on left After a few hours of pronounced vasomotor disturbances with elevation of temperature an recorded axillary temperature that was 1 degree higher on the right than on the left side all of disturbances of the autonomic nervous system diminished The left pupil became nearly as large as the right although the left enophthalmos continued noticeable for nearly 10 days

Seven days after the operation the improvement in voluntary motion had become striking Babinski reactions were negative the deep reflexes upon the left side alone were still hyperactive clonus was very inconstant There was improvement in all of the sensory responses but the sensory dissociation was still marked

Fourteen days after operation the patient walked her first letter and walked a few steps with assistance In everything except position sense on left side there now was marked improvement this one defect continued relatively unimproved even at the time of her discharge Of the involuntary reflexes already described only the tendency to fixate clonus in the left hand now persisted but certain new observations were made of reflex hyperexcitability in this region i.e. involuntary contraction of adjacent fingers when any one finger was forced extended involuntary flexion of the thumb forceful flexion of the middle digit (Mayer's reflex) etc

On October 3 cutaneous sensation was normal on the left side and had shown marked improvement in the right arm although not in the right hand Sense of position was normal on the right but seriously impaired on the left The patient walked freely dressed herself fed herself and wrote with fair ease She did not feel up to her normal strength however and all of these activities fatigued Involuntary reflexes had almost disappeared from the arms although they still persisted in the hand The Babinski responses were usually negative on both sides although an equivocal response could sometimes be obtained from the left foot A persistent ankle and patellar clonus was still to be observed on the left but not on the right and though there was no crossing of reflex responses from the left to the right side stimulation of the right patella caused slight contraction of the adductors The defensive reflexes had almost disappeared Finally it was striking that the Achilles tendon was still acutely sensitive while the right was almost anæsthetic so that it is evident that deep pain follows cutaneous pain pathways and not those of deep position sense

October 12 The patient was discharged At the time she was making slow but steady progress In her final examination it became clear that there was no association with her defective muscle and joint sense on the left side a marked impairment of two-point discrimination and an almost total astereognosis

Both of these sensory functions were unimpaired on the right side

On February 11, 1928 the patient reported that she had been back at her old position as stenographer for 2 months but that she still became fatigued easily and that her left arm and leg were a little weak and clumsy. In walking her balance was still slightly insecure and she continued to use a cane. Neurological examinations by local physicians showed that the left abdominal reflexes were still absent, that the knee jerk on the left side was still exaggerated and that there was a tendency to ankle clonus on the left. Earlier reports from the patient had showed that the astereognosis on the left side was improving.

In a later report written on March 8, 1928 she states: "My walking has greatly improved. I can walk quite a little faster and am much more sure on my feet and use the cane only when it is extremely slippery. I seem to have a great deal more confidence in my ability to stand on my feet, but I do stagger a little occasionally, that is I am apt to lose my balance if I do not watch myself, but as other people also notice that I walk better and I do myself I know there is an improvement. I am waiting anxiously for spring and clear sidewalks."

Last night I went through the test of identifying objects in my left hand and was able to name every one. I believe there were about a dozen. I am able to move things around in my hand and thus feel of them with my fingers, which of course makes it much easier to identify them. I do not believe that my hand is yet back to where it was before this last illness, but it is becoming more useful all the time and if I could but walk all right I could not complain at all. We also tried hot and cold glasses on my legs. Of course in the left leg I could tell both heat and cold immediately, but in the right the sense of heat was still a little lacking, although I could tell the cold glass at once. That sense of feeling also had improved over the last time. I was also able to tell every direction that my toes were moved in, except once in the left foot I missed, but evidently my sense of movement in that foot is improved. So taking it all in all I consider that there is a decided improvement. What do you think?

I still have the pain between my shoulders and in the back of my neck when overtired, but never unless I have worked too hard. I really feel that I can not ask for shorter hours, as I work only from 8:45 A.M. to 5 P.M. with an hour and a half for lunch, and I feel that they pay me too well and have been lenient with me for so long that I must get all the work done that there is to do, and I do not believe that I will have it when I have gotten stronger. I am sorry that I can not report any loss of weight. I am afraid I am not very good at dieting, etc.

#### DISCUSSION OF THE PRE-OPERATIVE AND POST-OPERATIVE COURSE OF CASE

In this attack, as in the earlier ones, the paralysis appeared first and persisted longest

on the left side. Nevertheless during the height of the process it was the right side which showed the more profound loss of power. The left side also showed from first to last more marked reflex hyperexcitability than the right. The explanation which naturally suggests itself for these seemingly paradoxical facts is that the right side suffered the more recent injury and hence manifested the flaccidity of spinal shock, while on the left side we were presumably dealing with a condition of chronic impairment of the upper motor neurones, spinal shock having long since passed off.

The distribution and recovery of sensory impairment were particularly instructive. There is much confusion in the clinical literature concerning the Brown-Sequard syndrome. In his *Course of Lectures on the Physiology and Pathology of the Central Nervous System*, delivered at the Royal College of Surgeons in England in May, 1858 (Philadelphia, 1860), Brown-Sequard deals at length with his experiments upon hemisection of the cord in animals and discusses the clinical correlations of his physiological observations. Here he describes clearly the effects of transecting half of the cord below the decussation of the pyramids (e.g., high in the cervical level). Thus on page 111 he says:

"In a spinal cord an alteration in a lateral half produces hyperesthesia and paralysis of movement in the corresponding side behind the place of the alteration (that is, caudal) and the loss of sensibility without the loss of movement in the opposite side (see 3, Fig. 21). Again on page 200 he says: 'Below the decussation of the pyramids a lesion in (half) the spinal cord produces paralysis in the same side and anesthesia in the opposite side. This is the simplest manifestation of the Brown-Sequard syndrome. A usual correlation which was apparently not recognized by Brown-Sequard or at least is not mentioned in his work is the loss of position sense on the same side as the lesion. Further analysis of the syndrome has been given by many subsequent writers, notably Schüttenhelm (28), Guernrohr (13), and Kron (22).'"

This patient showed clearly this classical dissociation: her paralysis appeared first on

the left side whereas the defective cutaneous sensibility was first noticed on the right. During the height of her illness the picture was recognizable although somewhat confused but again during her convalescence and at discharge the fundamental distribution of symptoms was in accordance with the classical law. Her chief motor weakness was again on the left side and her reflexes were exaggerated on the left. On the right side her motor power was practically normal but there remained a marked diminution in the acuity of her responses to pain, temperature and touch. Furthermore muscle and joint sense the fibers of which fail to cross within the cord itself was defective on the side of the greater motor difficulty (left).

Despite the loss of kinesthetic and postural sensations from muscles, tendons and joints of the left side, painful sensations from these structures (as from pinching the Achilles tendon) were acutely perceived on the right side. Deep pain was markedly diminished along with cutaneous pain. The fibers which mediate deep pain must therefore run in close proximity to those of cutaneous pain. It is significant that even with normal acuity of the sense of light touch on the left side the patient had nevertheless a high degree of posterior column astereognosis and a marked loss in power of discriminating two points.

Careful analysis of this patient's postoperative course shows that the various sensory and motor functions returned in the reverse order from that in which they disappeared. The left arm (though affected early) was the last to become completely paralyzed and it was the first to come back following operation. Similarly the left side was the last to become numb to pinprick and its sensation returned very much sooner than did the right. This indeed one would expect on *a priori* grounds.

It is also significant that throughout her period of recovery motor functions tended to return more quickly than sensory and of the components of sensation the slowest to recover completely were the more highly developed qualities of sensation such as light touch and the ability to perceive the texture of materials.

Pain on the other hand, returned more rapidly. This is important for it is known that pain is mediated by fibers of small diameter, and these being less susceptible to compression than larger fibers (Gasser and Erlanger '16) are likely to be less affected by a tumor than the larger fibers which mediate muscle sense and other of the more highly discriminative qualities of sensation. It may be emphasized also that pressure upon bundles of conducting nerve fibers such as those of the optic nerve and spinal cord may serve to interrupt the passage of impulses without destruction of the structures themselves.

#### THE GENESIS OF THE CYSTS

Both cysts were lined by ciliated columnar epithelium with a subjacent layer containing mucous and probably also serous glands. The wall of the cyst from the two year old infant had remained fairly simple connective tissue blood vessels a little smooth muscle a few nerve fibers and occasional polymorphonuclear neutrophilic leucocytes were all that could be found. The cyst from the 27 year old patient with a history of four or five attacks due evidently to increase in size of the cyst with resulting compression of the spinal cord had a more complex wall. Here the smooth muscle was well developed and abundant and patches of cartilage had also formed. There was evidence of recent infiltration with polymorphonuclear leucocytes and of a more longstanding accumulation of lymphoid cells not unlike atypical lymph follicles. There were also nerve fibers and possibly a few ganglion cells.

The classification of these cysts depends in part upon which of all these elements are held to be part of the primary heteroplasia and which are looked upon as accessory supporting or inflammatory adjuncts. Certainly the ciliated epithelium and the glandular elements are part of the primary tumor and it is difficult to regard smooth muscle and cartilage as purely reactive in origin. The cysts must therefore be looked upon as teratomatous in nature.

There has long been a feeling of uncertainty as to the nature and origin of cysts which are lined with ciliated cells. Within the skin itself



ectoderm rarely gives rise to cysts containing ciliated cells Hess (18) has reported one case For the most part such cysts arise only in case an entodermal vestige (branchial clefts neurenteric canal etc.) is the probable source of the tumor (Mallory 23) The morphological similarity of the linings of such cysts to the epithelium of the upper respiratory tract and of the fetal gut has impressed many observers and when as in these two cases mucous and serous glands have developed the analogy—particularly to respiratory epithelium—becomes even more striking It is nevertheless difficult to understand how a true implantation of entoderm can occur on the lower cervical or upper lumbar region of the spinal cord One is therefore forced to consider alternative interpretations

The second possibility which suggests itself is that the cysts were formed during the closure of the neural tube by a fortuitous in folding of ectodermal cells One must recall however that the ordinary dermoid or epidermoid cyst of the central nervous system is lined by stratified squamous epithelium the central cavity of the cyst containing a mass of desquamated fatty cells and often cholesterol (whence the name *cholesteatoma*) As is well known such cysts may also contain hair their surface moreover is often pale hard and glistening—which condition has given rise to the other name current for such neoplasms *Tumours Perlees* With these tumors the two cysts described here have little in common (see Bailey 3 Bailey 4 Cushing 7 Horrax 1)

A third alternative is that our cysts represent ciliated fetal ependyma Although the successful outcome of the operations made it impossible to establish the inner relationship of the cysts to the central canal of the spinal cord the direct connection of the cysts with the surface of the cord suggests that they might have arisen by an extramedullary outpocketing of the central canal—an extramedullary syringomyelia (see Andre Thomas and Quercy 1) This neurogenic interpretation receives some support from the finding of a clump of what appear to be ganglion cells in the wall of cyst 2 and of bits of nerve fiber in both However no glial elements were

present and such an explanation fails to account for the presence of mucous and serous glands associated in normal structural relationship with an ependymal derivative

The final possibility acknowledges our inability to make any of the preceding theories harmonize with all of the facts and suggests merely that any type of fetal epithelium whatever its origin may under special unknown circumstances develop columnar epithelium possessing cilia If this is the case the effort to find close analogies in adult tissues is obviously useless

Though inclined toward the last of these various hypotheses we find ourselves quite unable to make a definite choice without the further information which could be gained only at necropsy The cysts may therefore be looked upon as teratomata with entodermal epithelium and gland to which have been added ectodermal elements (nerve fibers) and mesoblastic structures or they may be thought of as dermoid which for unknown reasons have undergone a type of epithelial and glandular development which is rare in the central nervous system and which have added a mesoblastic component or finally they may be interpreted as ependymal in origin with epiblastic (glandular) and mesoblastic additions

#### LITERATURE

A careful search of the literature has revealed no record of cases which are exactly comparable to the cysts reported here A few instances of tumors have been gathered together however because they have features which suggest analogies to the two cases

In 1866 Eberth (9) described a cyst imbedded in the occipital lobe of the left hemisphere The cyst was club shaped and the narrow canal of the handle stretched toward the occipital pole of the posterior horn of the lateral ventricle finally merging with the ependyma of the ventricle by a solid stalk This cyst was lined by a columnar ciliated epithelium and Eberth believed it to be a heterotopic bit of ventricle in which the ependyma had retained its fetal cilia He comments that as frequent as are cysts in the brain with a lining of flattened pavement

epithelium so rare are cysts with a columnar ciliated lining<sup>1</sup>

In 1887 Strassmann and Strecker (29) described a polycystic tumor of the choroid plexus of a three year old boy. The cyst walls contained ganglion cells nerve fibers glia connective tissue smooth and striated muscle hyalin and fibrous cartilage bone fat acinous and tubular glands with cylindrical epithelium blood vessels and hemorrhage. The cysts were lined by single layered and stratified epithelium and in some instances the epithelium was ciliated. Presumably this latter type of epithelium was composed of columnar cells but the structure of the epithelium of the cyst as a whole is not made clear. Nor is it clear whether the glands were of the type of mucous glands.

In 1894 Arnold ( ) described an anomaly which was found at autopsy in a child that died shortly after birth. There was a spinal bifida with a huge double external cyst. The inner cyst was composed of a myelomeningocele the wall of which contained nerve cells and glia muscle fat glands and cartilage. The cyst was lined with cylindrical epithelium which was continuous with the ependyma of the central canal. The presence of neural elements in the wall of a myelomeningocele is of course to be expected and the accompanying development of mesoblastic tissue might well be interpreted as a response to the need for support of this anomalous structure. The presence of gland like elements however suggests a relationship to our two cases especially to the child with the spinal bifida occulta. Unfortunately the exact nature of these glands is not made clear.

In 1896 Saver (26) described a large nodular and cystic tumor which was found in the third ventricle of a 7 weeks old child attached only to the tela choroidea. This tumor contained neural elements epidermal

elements (glands cysts etc) muscle and cartilage. The exact nature of the cyst epithelium and of the glands is not made clear, but the occurrence of such a tumor at this point of mid dorsal closure of the neural tube is in many ways analogous to the two cysts described in the present report.

Rosenthal in 1898 (24) described an intra medullary tumor which he called a neuro epithelioma gliomatous microcysticum. The tumor was in the lower dorsal cord and seemed to have connections both with the central canal and with the meninges. It contained multiple cysts and canals which were lined by cylindrical epithelium on the free border of which occasional cilia were seen. The tumor terminated above in gliosis and below in gliosis and a syringomyelia of the central canal. The cells lining some of the cysts suggest ependymal derivation but other cysts as seen in the illustrations are gland like with albuminous contents (Rosenthal). Whether this tumor is in any sense analogous to the two under discussion here is doubtful because of its intramedullary position but the gland like appearance of some of the cysts and the meningeal attachments make it possible that it could be a similar tumor which has become infolded within the cord itself.

In 1898 Fraenkel and Benda (11) described a group of multiple cysts which seemed to arise from the meninges but which nevertheless were lined by an epithelium which suggested ependyma. It is not clear whether these cysts actually attached to the cord itself.

In the same year Trachtenberg (30) reported a case which is relevant only because it affords a sharp contrast to the essential structure of these two cysts. The patient had multiple tumors of the arachnoid over the dorsal surface of the cord from the cervical region to the crura equina. These tumors were small nodules containing a soft yellowish pulp within a thin wall. The thin walls were made up of connective tissue without epithelial covering smooth muscle fat balls of horny epithelial cells and sebaceous glands. These glands were lined by stratified squamous epithelium only two small glands were seen near the others with columnar epithelium.

A m l cyst h y t b po t d by f l t w (4)  
d t f d g m w h d h y phy l t m w l l h h  
als t t l y h f boy f f f m w h t d t l f g t c y t f d d  
f t a l t e d l l w asp t e d d g t v i f l y t l x p l t  
p m d p as l l t m t b l i v i f l y t l x p l t  
hypophyseal y t b as th l t m t b l i v i f l y t l x p l t  
b p d f i f i t t h h i d e c e r l and h s s w  
w l l ( t B B H S g N 30037 ) l t t y t l h g i n h p  
h f c y t t s g l t d l l p d y m l h i n w h t h  
they p e s e t s o p h y s i c a l  
t m l y f w t p o t f m p l t m t  
N f t h h w p a r a l l s p t w a s e g b y t h t h

lum but without clear lumina. The author believes these to be typical multiple dermoids of the central nervous system and they show the structure which is characteristic for the usual dermoid tumors of this region in contrast to the tumors reported here. Similarly Hale White and Fripps (17) dermoid (containing stratified epithelium, sweat glands and hair follicles) at the third dorsal level has little in common with our cases. Herzogs (19) ependymal cyst of the cerebellum did not contain ciliated cells.

In 1902 Siver (27) Case 3) reported another tumor of the leptomeninges which filled the lower lumbar and sacral canal with a large jelly like cystic mass which was lined by papillae of tall epithelial cells. Any connection with the cord is not clearly demonstrated but the author suggests a possible origin in the filum terminale and believes that the epithelium may be ependymal in nature.

In 1904 Bittorf (6) described in the dorsal cord of a 35 year old man a tumor which lay in the subarachnoid space attached to the spinal cord. It was cystic and was lined by cubical or cylindrical epithelium which was stratified at places. A cuticle or possible cilia could be seen (the material was imperfectly fixed in formalin). The cysts were in continuity with syringomyelic cavities within the cord. At a slightly lower level of the cord a neuroma like nodule was seen which recalls the similar associated defect which was observed at operation in the first of our two cases.

Andre Thomas and Quercy (1) reported a similar case in 1911 but unfortunately no clinical details were available. A cyst communicating with the central canal of the spinal cord at the 5th or 6th cervical level (causing the cord in this region to be extremely flattened) was found to contain glial elements (superficial) connective tissue, striated muscle, many blood vessels and was lined with typical polyhedral ependymal cells but no mention is made of their being ciliated. There was also a dilatation and gliosis of the central canal from the cervical to the lumbar region.

Bielschowsky and Unger (5) describe (with full clinical details) a somewhat similar case of extensive gliosis and syringomyelia asso-

ciated with a teratomatous area in the upper cervical cord which contained in rows hairs with foreign body giant cells and several small cysts lined with skin like epithelium. The case came to necropsy following operation and was carefully studied.

Frazier (12 p 513) mentions having operated on one teratoma and two dermoids of the cord and Elsberg (10 p 248) states that he removed a spinal cord cyst but no clinical or pathological details are given concerning any of these four cases.

Finally without venturing any answer the question may justly be raised whether these cysts have any relationship to the papillomata of the choroid plexus described by Davis and Cushing (8). One must allow for the fact that the papillomata arise within the ventricle and develop an abundant villous like structure whereas these cysts if pushed outward from the canal could develop only a limited papillary infolding within the confines of the tense and distended sac. Nevertheless except for the lack of cilia there are striking resemblances in the cell morphology and granulation of the epithelial layer of the papillomata and of the cyst. Moreover it is striking that it is in tumors of the choroid plexus or tela choroidea which have attained a somewhat more complex structure than these described by Davis and Cushing (i.e. those of Strassmann and Strecker and of Saver 1896 q.v. above) that malformations most closely resembling our two cysts have been reported. In any case it seems justifiable to conclude that the whole line of dorso medial closure of the neural tube is a region in which a teratomatous or dermoid tumor of the central nervous system may form which is unlike the usual dermoid of this organ in that it may contain a ciliated epithelium resembling fetal ependyma elements which are clearly neural and other quite unrelated structures such as gland, smooth muscle and cartilage.

#### SUMMARY

Two cases of teratomatous cysts of the spinal cord are described which were successfully removed at operation. Both contained ciliated cells. The first patient a

child of 2 years who came under observation because of irritability and tender abdomen gave a history of always having dragged its right foot. Repeated lumbar punctures at tenth eleventh dorsal vertebræ level gave thick egg white fluid filled with ciliated cells. At operation a large flattened cyst was found extending from tenth dorsal to fourth lumbar vertebræ. Histologically it proved to be a relatively simple teratoma lined with ciliated columnar epithelium. The child recovered and became symptom free.

The second patient an unmarried female American of 27 had had five attacks of left hemiplegia with pain in left cervical region and Brown Sequard dissociation of sensation in trunk and extremities (pain and thermic sense absent on the right loss of position sensation on left with astereognosis) at varying intervals since the age of two. Her present attack developed into an almost complete quadriplegia with an upper level of sensory disturbance at fourth cervical and grave embarrassment of respiration. Dr Cushing removed a cyst filled with mucus and ciliated cells attached to the left side of the cord at the third fourth cervical vertebræ level. Histologically this cyst was found to be a more complex teratoma than the preceding with changes compatible with its greater age. After operation patient had an immediate and dramatic recovery of power with marked though less complete return of sensation. Both cysts were congenital and probably represent ependymal diverticula of the central canal of the spinal cord.

## BIBLIOGRAPHY

- ANDRÉ THOMAS and QUERCY Syringomyélie hyperplasiée du tissu conjonctif fibres musculaires striées dans la moelle. *Nouv. Icon. de la Salpêtr.* 1912 xxv 264-383.
- ARNOLD J. Myelocyst. Transposition von Gewebeskeimen und Sympodie. *Ziegler's Beitrage* 1894 xvi 1-17.
- BAILEY P. Cruveilhier's Tumeurs Perlées. *Surg. Gynec. & Obst.* 1920 xxxi 390-401.
- BAILEY P. Further observations on pearly tumors. *Arch. Sur.* 1914 viii 523-534.
- BIELSCHOWSKI M. and UNGER E. Syringomyélie mit Teratom und extramedullärer Blastombildung, zur Kenntnis der Pathogenese der Syringomyélie. *J. f. Psychiat. u. Neurol.* 1919 xxv 173-218.
- BITTORF M. Beitrage zur pathologischen Anatomie des Gehirns und Rückenmarksgeschwulste. *Beitrage* 1904 xxxv 169.
- CUSHING H. A large epidermal cholesteatoma of the parieto-temporal region deforming the left hemisphere with cerebral symptoms. *Surg. Gynec. & Obst.* 1922 xxxv 557-566.
- DAVIS L. E. and CUSHING H. Papillomas of the choroid plexus. *Arch. Neurol. & Psychiat.* 1921 xiii 681-710.
- EBERTH. Flammerepithelcyste im Gehirn. *Arch. f. path. Anat. etc.* 1866 xxxv 479-480.
- ELLSBERG C. A. Diagnosis and Treatment of Surgical Diseases of the Spine and its Membranes. *Philadelphia W. B. Saunders Company* 1916.
- FRAENKEL A. and BENDA C. Zur Lehre von den Geschwulsten der Rückenmarkshäute u. s. w. *Deutsche med. Wchnschr.* 1898 July 28 p. 476.
- FRAZIER C. H. Surgery of the Spine and Spinal Cord. *New York D. Appleton & Company* 1918 971 pp.
- FUERNBERG W. Ein Fall von Brown Sequard'scher Halbsseitenlähmung. *Deutsche Ztschr. f. Nervenheilk.* 1902 xxii 15-23.
- FULTON M. An epithelial cyst of the hypophysis. *Am. J. Path.* 1928 iv 87-93.
- FULTON J. F. Observations upon certain spinal reflexes of man and their relation to the tonus of skeletal muscle. *J. Nerv. & Ment. Dis.* (in press).
- GASSER H. S. and ERLANGER J. The differential action of pressure on fibers of different sizes in a mixed nerve. *Proc. Soc. Exper. Biol. & Med.* 1921 xxiv 313-314.
- HALE WHITE W. and FRIPP A. B. A case in which the attempt was made to remove a dermoid tumor. *Tr. Clin. Soc. London* 1900 xxxiii 140-145.
- HESS K. Ueber eine subcutane Flammerepithelcyste. *Ziegler's Beitrage* 1890 viii 98.
- HERZOG M. Eine ependymartige Ependymcyste im Kleinhirn. *Centr. f. Path.* 1899 x.
- HERZOG M. *Acta Path. et Microbiol. Scand.* 1926 Supp. vol. 1.
- HORRAX G. A consideration of the dermal versus the epidermal cholesteatomas having their attachment in the cerebral envelopes. *Arch. Neurol. & Psychiat.* (Sept.) 1922 viii 265-28.
- KRON J. Experimentelle Beitrage zur Lehre von der Hemmung der Reflexe nach halbseitiger Durchschneidung des Rückenmarks. *Deutsche Ztschr. f. Nervenheilk.* 1901 xxi 24-53.
- MALLORY F. B. Sacro-coccygeal duplex sinuses and cysts. *Am. J. M. Sc.* 1892 ciii 263-280.
- ROSENTHAL W. Ueber eine eigenthümliche mit Syringomyélie complizierte Geschwulst des Rückenmarks. *Ziegler's Beitrage* 1898 xxiii 111.
- SABIN F. R. Studies of living human blood cells. *Bull. Johns Hopkins Hosp.* 1923 xxxiv 277.
- SAXER F. Ein zum grössten Theil aus Derivaten der Medullarplatte bestehendes grosses Teratom im viii Ventrikel eines 7 wöchentlichen Kindes. *Ziegler's Beitrage* 1896 ix 399.
- SAXER F. Ependymepithel Glome und epitheliale Geschwulste des Centralnervensystems. *Ziegler's Beitrage* 1902 xxvii 276.
- SCHITTENHELM A. Ueber einen Fall von Stichverletzung des Rückenmarks. *Deutsche Ztschr. f. Nervenheilk.* 1902 xxii 1-14.
- STRASSMANN F. and STRECKER C. Ein Teratom in rechten Seiten entrikel. *Arch. f. path. Anat. etc.* (May) 1887 cviii 351.
- TRACHTENBERG M. A. Ein Beitrag zur Lehre von den Arachnoidealen Epidermen und Dermoiden des Hirns und Rückenmarks. *Arch. f. path. Anat. etc.* 1898 cliv 24.

ORIGINAL FEATURES IN ARTHROPLASTY OF THE KNEE  
WITH IMPROVED PROGNOSIS<sup>1</sup>

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TO the patient with bony ankylosis of the knee a functioning joint with adequate mobility and stability is his object in seeking an arthroplastic operation. Whether or not the surgeon follows anatomical contours in modelling the new joint does not interest him so long as the joint *functions*. It has been found by Allison and Brooks that it is absolutely impossible to duplicate experimentally or in surgically constructed joints at the knee the *normal gliding of the articular bone surfaces*. This being true and as attempts to approximate the contour of the normal joint are so often followed by lateral instability, I have devised a technique based on well known mechanical principles which ignores the normal contours of the joint and provides both mobility and stability. It has given excellent results in 10 cases.

In the bone modelling wide V shaped incisions replace the usual attempts to follow normal bony contours when viewed anteriorly (Fig. 1). The convex wedge shaped plane surfaces of the femur fit accurately into the concave wedge shaped plane surfaces of the tibia. Weight bearing forces the apex of the wedge shaped end of the femur so firmly into the tibia that the danger of lateral instability is practically eliminated and a definitely improved prognosis is afforded.

At the Sixth Congress of the International Society of Surgery held in London in 1913 arthroplasty was one of the major subjects of discussion and it is noteworthy that opinion was at that time divided between those who still believed arthroplasty of the knee to be extremely hazardous and those who felt that the field for its use was definitely enlarging—that to undertake it in carefully selected cases should no longer be regarded as indication of undue surgical boldness.

Eight countries were represented in this discussion.

Italy Putti France Tuffier Leriche  
Santy England Hey Groves Ireland De

Courcy Wheeler and Stoney Czecho Slovakia Jirasek Spain Ribas Ribas Sureda and Corachan Poland Jurasz a former pupil of Ilyr and America MacAusland. Many good results were reported by Putti and MacAusland suggested certain changes in technique. Jones and Lovett in the same year stated that the operation was still on trial (7).

Up to 5 years ago my own attitude concerning arthroplasty to produce mobility in bony ankylosed knees (fibrous ankylosis will not be considered in this paper) was one of great conservatism both because of personal experience and because of observations which I had made upon several of Dr. Murphy's cases of arthroplasty which had subsequently come to me before and after his death. These patients either had insufficient motion to satisfy them or more often the degree of mobility was satisfactory but lateral instability was present and proved so troublesome as to offset the advantages of mobility. In view of such results following Murphy's excellent technique and of my experience with three personal cases prior to 1920 I adopted the attitude that a patient would have to persuade me into undertaking an arthroplastic procedure upon the knee. In 1910 I devised the technique described and applied it to two cases with good results between 1920 and 1922 nevertheless I kept a conservative attitude until 1923 when a patient (Case 3) for whom I had done an arthrodesis 4 years earlier for old tuberculosis of the joint returned and begged me to perform an operation to give her motion. Her parents were equally urgent in their plea.

The tuberculosis had existed since the patient was 17 months of age. The arthrodesis had been performed when she was sixteen. At this operation the posterior part of the patella the infected posterior portion had been sawed away and the rest of the patella left with one half of its posterior cut surface in contact with the femur and one half with

the tibia for the purpose of supplementing bone growth and of acting as a pedicle graft in producing the ankylosis. This procedure was contrary to the older methods in which the patella was enucleated but proved very fortunate when the subsequent arthroplasty was attempted.

If ever my position was one of demanding persuasion to do an operation it was in this case as I was fully aware of the danger of causing a relapse of the old tuberculosis as well as of the unfavorable prognosis in arthroplasty of the knee. Both patient and parents were however so persistent in their request that I finally consented to operate but only after assurance by all that I would be absolved from any responsibility or blame if the tuberculosis relapsed or the result of the operation proved unsatisfactory. Quite contrary to my expectations the result was excellent. There was adequate mobility and no lateral instability (Figs 9 to 11).

In the light of the good result in this case my point of view regarding arthroplasty of the knee changed considerably and I have since operated on 7 cases with good results making a total of 10 cases.

With proper selection of cases, meticulous attention to technique and intelligent postoperative physiotherapy I believe that the prognosis for arthroplasty of the knee is good. The technique devised in the two earlier cases (190 and 1921) was used in the case just described and has been followed in all subsequent cases. It contains several original features which diminish the danger of lateral instability and make the early application of physiotherapy possible.

#### AUTHOR'S TECHNIQUE

A tourniquet is applied well up on the thigh so as to allow postoperative application of plaster of Paris before the tourniquet is removed.

The knee is approached by a U shaped incision in the skin and soft parts from the inner and outer aspects downward to just below the tubercle of the tibia. It does not extend up the thigh as does Putti's incision. The concavity is upward. This U incision gives the surgeon absolute uninterrupted

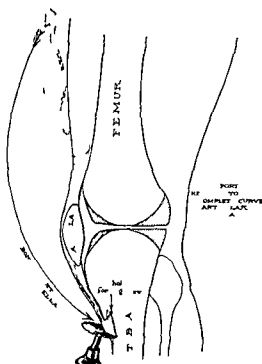
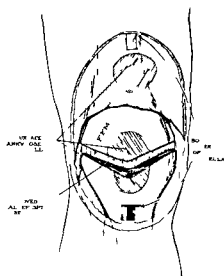


Fig 1 Schematic drawing in lateral view, sagittal plane showing author's method of turning up the ligamentum patellae with its bony insertion, the patella and the quadriceps tendon. Note modelling of the bony elements of the joint.

access to all the parts involved in the formation of the new joint and is therefore distinctly superior to the lateral approach. Also it does not interfere with the important extensor apparatus above the knee as is likely to happen with the inverted U incision or lateral approach.

The technique of arthroplasty should be so designed as to allow passive and active motion at the earliest possible moment without danger of separation of important structures. As the free gliding of the soft structures or extensor apparatus just above the knee joint is absolutely essential to free motion and active control the severing and resuture of these structures as in the inverted U incision is to be avoided for if they are severed not only is there danger of union being insufficient when one wishes to start exercises and passive motion as early as weeks after operation but because of the cross section severance there is danger of adhesions at this point between the gliding intramuscular and tendinous tissues. These considerations lead me to choose an incision which does not section or traumatize these soft structures.



I k S l m t l l k l m k th m t l f  
t n p th l t l l l m t m j t l l x th t  
t tt hm t t th t l l f th t l m N t th  
m th d f m al f l b l l l l f d  
t m k tl f m l l j t

above the knee and to turn the patella upward rather than downward is advocated by certain authors.

When the knee is being opened up care should be taken to leave the skin flap overlying the interior work as thick as possible so that the skin and line of suture will not break down following operation.

Before the patella is turned upward the ligamentum patellae is detached with a generous amount of bone from the region of the tibial tuberosity in the dovetail manner indicated in Figure 1. First two holes for later insertion of kangaroo tendon are drilled one through the tibial tuberosity and one slightly posterior to it. Then by means of the motor saw and small drill the tubercle of the tibia including one drill hole is removed with the ligamentum patellae and the patella turned upward. This bone plastic work is done very rapidly with the Albee motor saw and because of the dovetail mortice conformation and the rapid union of closely fitted broad bone surfaces to bone surfaces the surgeon need not question the detachment of the ligamentum patellae—a question which has been raised by MacAusland who considers it inadvisable to sever or disturb the patellar

tendon or its attachment. It is distinctly preferable to detach this tendon as trying to work around it involves unnecessary trauma to neighboring tissue slows up the operation and limits access to the joint.

It is well known that bone unites to bone more readily and more firmly than tendon to tendon or fascia to fascia. The author's method of detaching the ligament takes advantage of this: the dovetail mortice conformation being a further assurance of prompt union and of the prevention against the pulling away of the tendon from the tibia even when bony union has not taken place. Prompt union obviates delay in the application of postoperative physiotherapy, which should follow within 2 weeks after the arthroplasty. In marked contrast to this is the union of a severed tendon to tendon which is both slow and unreliable. Putti's method of nailing the ligamentum patellae and tibial tubercle in place with a double headed nail does not insure as prompt or as firm union and has all the disadvantages which attend the introduction of foreign bodies into living tissues. In reviewing the literature I find that Kirschner has successfully used a method somewhat similar to mine.

After the ligamentum patellae has been thus detached the soft tissue and capsule are dissected from the ankylosed joint to which they have become amalgamated and the whole mass—patella, quadriceps and soft parts—turned upward exposing completely the interior and lateral surface of the junction of the tibia and femur (Fig. 1).

At this juncture the gliding of the lower part of the quadriceps muscle and its tendon upon the lower end of the femur is tested as well as their length. If this tendon and muscle do not glide up and down satisfactorily and are not of sufficient length plastic work should be done to lengthen the tendon as well as to bring about its satisfactory gliding on the lower end of the femur. This is a very important feature of the operation because if the tendon is not long enough to allow postoperative flexion or if the quadriceps tendon is not free serious interference with postoperative physiotherapy or mobilization of the joint will occur.

Severance of the quadriceps tendon or muscle becomes unnecessary when my technique is used and this is well since severance necessitates the suture of soft part to soft part fascia to fascia and muscle to muscle thus tending to shorten these structures as well as to delay early physiotherapy by slow union. It has been my practice to remove all immobilizing splints at the end of weeks and to institute active and passive motion. If the quadriceps tendon were severed this early postoperative treatment would certainly jeopardize union. Again the severance of the quadriceps muscle and tendon and the dissecting downward of the distal portion seriously involve the gliding structures above the patella which may not have been damaged or destroyed by the original pathology which produced the ankylosis.

After the patella quadriceps and soft parts have been turned upward *en masse* one is then ready for the bone arthroplasty. It has been found by Allison and Brooks that it is absolutely impossible to duplicate experimentally or in surgically constructed joints at the knee the normal gliding of the articular bone surfaces. This being true and attempts to approximate the contour of the normal joint being so often followed by lateral instability it has seemed best to use one's mechanical ingenuity to bring about desirable functional results on an entirely different mechanical plan. Therefore my technique does not follow the confirmation of the normal knee. By making use of well known mechanical principles I have overcome the disadvantages with respect to lateral instability of an arthroplastic joint modelled after the normal anatomical joint and still obtain adequate mobility.

With a broad osteotome parallel broad V shaped incisions with the apex downward are used in modelling the joint anteriorly (Fig 2).

The lower end of the femur as viewed from its anterior surface is shaped into a wedge with an angulation of 120 degrees between its plane surfaces. This leaves the tibia with concave plane surfaces at an angle of 120 degrees to each other. These are in turn carefully modelled so as to receive with accurate fit the convex wedge shaped surface of the

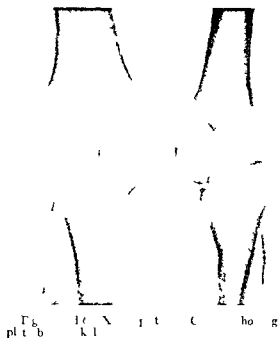


Fig 3 (left) Lateral view showing author's method of erosion to secure arthrodesis in a tuberculous joint leaving the patella intact as well as realize that the latter is an important item in a new formed joint following arthroplasty. Note strong bone graft tibia pegs in situ.

Fig 4 Anteroposterior view of the same case showing location of strong tibia peg taken from the same tibia lower down with the author's motor saw.

femur. This is one of the original features of the operation and is an effective measure in the avoidance of lateral instability in that from a mechanical standpoint weight bearing forces the wedge contour of the lower end of femur into the corresponding wedge shaped cavity of the upper end of tibia. This peculiar contact practically insures stability and consequently an unusual amount of laxity can be permitted by removal of an ample amount of bone. A generous amount of bone particularly at the posterior part of the joint is removed from what was the tibia and femur and the remainder is so shaped that it will imitate so far as possible the normal contour of the joint. However even more bone is removed from the posterior condyles at this point. Great care should be taken not to leave any blocks of bone attached to soft parts in the popliteal space because of the danger of their acting postoperatively as osteogenic material. It must be remembered of course that the removal of too much bone will favor instability but the wedge shaped method just described markedly diminishes this possibility.





Great care should be taken to leave the bony surface as smooth and plane as possible to facilitate gliding. This is usually best accomplished with a sharp ( $\frac{1}{2}$  inch) osteotome but a file may be used if necessary. A close study of the conformation of the bony surface of the new joint should be made in order to shape them most favorably for the function of joint motion. The proper conformation of the joint should then be tested by flexing the knee to beyond a right angle. Free motion without impingement at any point of one surface upon another should be striven for before the free fascia and fat graft is obtained.

The patellar ligament with its dovetail bone fragment is then replaced in the original mortice bed and sutured down by kangaroo tendon through the prepared drill holes.

The joint is again flexed very cautiously to at least a right angle to check up on the contours and to insure free excursion of the quadriceps tendon and muscle so that postoperative physiotherapy will not be prevented from the securing of the desired motion.

The joint is then packed with hot saline compresses while a rectangular graft of fascia lata and fat is being obtained from the central portion of the outer aspect of the

thigh. Being a semifluid substance the fat under pressure after joint closure practically flows into the cavities and absolutely fills up all peri-articular dead spaces thus preventing the formation of hematoma. For this reason the inclusion of fat with the fascia lata graft seems to me very valuable and I cannot agree with those who advocate the use of fascia lata alone.

If sufficient fat can be obtained with the fascia the superior portion of the graft is split and the undivided portion placed between the tibia and femur. The fascial portion of the split end is turned upward and inserted between the lower end of the femur and the quadriceps tendon and the patella while the fatty portion is turned downward and placed between the upper end of the tibia and the mentum patellae and the patella. The graft is sutured with chromic catgut No. 1 to the remains of the capsule and soft tissue. The remains of the capsule are then sutured medially and laterally with chromic catgut No. 1 and the skin closed with plain catgut No. 0 and sterile dressings applied.

Moleskin straps are applied medially and laterally to the lower leg for traction to obviate muscle spasm and consequent injury to the fascia lata transplant by crushing between joint surface and allo to keep the bone ends apart.

Then a cast is applied so constructed as to allow for traction by means of the moleskin. The tourniquet is not removed until the plaster applied from below upward has reached it. Certain surgeons remove the tourniquet before they close up the wound. This is to be condemned in that in an arthroplasty there are such broad surfaces of raw bone that the large amount of bone ooze cannot be controlled by ligature. Careful observation shows that a larger amount of bleeding will come from the cut bone surfaces than from the small blood vessels which will escape ligature if the tourniquet is left on. The compression and immobilizing effect of plaster of Paris with all joint space filled with the fat and fascia graft acts as a marked hemostatic influence and it is therefore preferable to leave the tourniquet on thus preventing the very considerable oozing from the

bone surfaces which would occur were it removed. The hazard of hematoma is a real one and should be carefully guarded against.

A pulley and traction apparatus upon the bed must be ready for immediate application when the patient returns from the operating room. The patient is held completely under the anesthetic until traction of 15 pounds is well established upon the limb. This is done to prevent muscle spasm which is likely to occur as the patient comes out from under the anesthetic and which might cause the approximation of the bone surfaces and the crushing of the fascia and fat graft between the bone surfaces. The latter might be a real calamity leading to reankylosis.

This traction is continued for at least 1½ months after the plaster is removed and massage begun. Even after the patient goes home the traction is maintained throughout the night although during the day the patient is allowed to walk with crutches *without weight bearing*, the latter not being permitted until at least 2 months after operation.

This technique has been followed in the 10 cases which are reported herewith.

To date approximately 500 arthroplasties of the knee have been reported in the literature, about one third of these being for bony ankylosis (Table I).

#### ESSENTIALS IN TECHNIQUE OF ARTHROPLASTY

The essential features in the technique of arthroplasty are (1) approach to the joint (2) the freeing of the ankylosis (3) thorough eradication of all soft parts which might favor reankylosis such as pathological neoform tissues synovial debris cartilage fibrocartilage capsule (4) meticulous modelling of the articular surfaces so as to allow free motion and at the same time avoid lateral instability (5) interposition of a tissue capable of arresting osteogenesis and of maintaining the separation of the new formed articular plane and at the same time of stimulating a minimum amount of tissue reaction (6) closure of soft parts with care as to apposition so that there will be no leakage through the line of suture (7) immobilization with traction and (8) intelligent postoperative physiotherapy.



Fig. 7 (left) Roentgenogram following arthroplasty. Case 2 showing wide V shaped method of removal of bone and shaping new formed joint.

Fig. 8 Lateral view following arthroplasty. Case showing modelling of joint.

A great variety of means are used by different surgeons to attain these fundamentals. Modifications are made to suit the particular case and experience with postoperative results suggests further modifications such as those in the earlier part of this paper under author's technique. In this connection it is interesting to review briefly the history of arthroplasty and the various methods now in vogue since it cannot be said that there is at present any standard technique for this operation upon the knee.

To Verneuil (1863), Ollier (1888) and Helfferich (1894) belongs the credit for the original conception of mobilizing ankylosed joints. Their procedure was of the nature of a resection rather than a true arthroplasty. Modern asepsis has made entering the joint and complicated technique less dangerous than in their day. Helfferich is credited with the first success with the interposition method. Murphy and Putti have done much to perfect the technique. It is curious that although the idea of arthroplasty is essentially a French idea France has until recently been one of the most conservative of its advocates so far as the knee is concerned.

TABLE 1—ARTHROPLASTICS OF THE KNEE  
REPORTED IN THE LITERATURE

A. h.	C.	R.	A. h.	C.	R.
Alg.			K. m. so.		
B.	8	5	L. v.		
C. m. p. h. l.	55	4	L. I. t.		
C. b. l.	3	8	L. m. t.		f
Ch. o. l.			Le. h.	4	3
Co. h.	f		Le.		
Ca. m.			M. A. l. l.		
D. C.			M. C. l. v.		
Wh. l.			M. l.		
D. m. t.	3		M. C. l. (f)		
D. l. t.			H. l. l.		
D. t. h. l. d.			M. r. l.		
D. l.			N. f.		
D. t.			Olg. y.		
o. l. l. t. h.			O. g. o. l.		
Eud. l.			I. y.		
F. k.	f		P. g. S. l.		
G. t. h. l.			P. t. t.	3	5
vo. H. k.			R. h.		
H. d. so.	8	4	R. t.		
H. C.	9	9	Ry. so.		
H. t.			S. h. t.		
Hoff.			S. h. p. l. m.		f
H. f. m.	f		S. h. m. t.		f
H. b. h.	f		Sta. h. ff.		
I. g. b. n. g. t.			T.		
K. k. l.			T. b. b.		
(f. k.)	3		Tuff.		
K. h.			V. d.		
N. t. t. m. p. t.			W. t. h.	3	3
l. f. y. th.			W. l. m.	3	3
l. t. t. t. t. b.			Z. r. a. l. k.		
o. m. y. th.					
t. t. th. p. o. t.					
th.					
a. k. y.)					
† + 3 f.					
4 (f)					
§ + f					

In 1911 Ollier who had obtained very encouraging results from experimental arthroplasties on the knees of animals hesitated to apply to human surgery what he had thus worked out because of the consensus of opinion against such interference. But his own conviction in the matter is expressed by this question: Is ankylosis in good position the last word in surgical art? Ought we ever to stop trying to attain on the knee what we obtain so routinely on the other joints: the shoulder the wrist the elbow.

#### INDICATIONS AND TECHNIQUE FOR ARTHROPLASTY

Those who have had the widest experience and the greatest success with arthroplasty are unanimous in urging careful selection of

patient. In so doing the following point should be considered: (1) the original cause of the ankylosis (2) the position of ankylosis (flexion extension hyperextension) and (3) the condition of the patient—not merely the general physical resistance but the psychosocial and occupational factors.

*The original cause of ankylosis.* Trauma suppurative arthritis gonorrhoea tuberculosis is osteoarthritis and rheumatoid arthritis are the usual causes of ankylosis arranged in order of suitability for arthroplasties.

With regard to the advisability of operating upon a case of *bony ankylosis due to tuberculosis* there seems to be the greatest difference of opinion. I believe such joints should be approached with due conservatism but not pessimism. Lutter, Lexer and Henderson consider it a definite contraindication. Putti apparently bases his opinion entirely upon theory; we have not been able to find a tuberculous case in his published series. Henderson has done an arthroplasty on two knees in which ankylosis was of tuberculous origin. Both of the knees were operated upon on a mistaken diagnosis. Neither gave a satisfactory result. Although he does not advise arthroplasty in tuberculosis of the knee he has done successful arthroplastic on several cases of healed tuberculosis of the elbow joint. Murphy considered the prognosis unfavorable. Baer, Langer and Hey Groves consider the prognosis good if the cases are properly selected and I subscribe to this opinion one of my most brilliant results being in a case of old tuberculosis.

Chevalier believes that in general since there is no way of proving absolute cure of tuberculosis it is better to leave such cases alone but that since there are reported in the literature a certain number of good results arthroplasty ought not to be absolutely rejected and is permissible in three instances: (1) In cases which have apparently been cured if the patient insists on arthroplasty (2) in cases which have apparently been healed for a long time and the knee is ankylosed in flexion. If on opening the joint a tuberculous focus or suspicious looking tissue is found a resection can be done and the patient will be as well off as before. If no



Fig 9

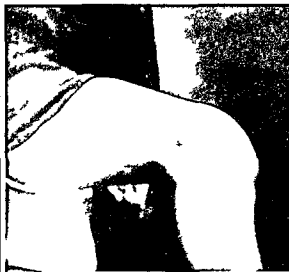


Fig 10



Fig 11

Fig 9. Active extension on Case following arthroplasty.  
Fig 10. Postoperative view Case showing degrees of active flexion.

Fig 11. Shows excellent range on newly formed joint Case. A added motion. Little lateral stability.

If a lesion is found arthroplasty will give the patient the chance of gaining mobility (5). In cases in which arthrodesis has been previously performed. In such cases cure of the tuberculosis is most probable and when X rays show that the ankylosed bone has sufficient dimensions to allow for arthroplasty it seems most reasonable to attempt it if the patient so desires. Payr has done this and has tried to make up for the absence of the patella by special tendinous grafts. Although the results have not always been good Chevalier finds them distinctly preferable to complete ankylosis.

I am in complete accord with points 1 and 2, but fail to see why ankylosis in flexion is a special indication for arthroplasty.

In determining the operability of tuberculous cases the surgeon finds that careful X ray study in several planes and by stereoscopic views serves as a very valuable and trustworthy adjunct in fact X ray technique has now been so perfected and reveals such excellent detail that if the surgeon make the best of this opportunity in selecting cases and does not undertake arthroplasty until 4 or 5 years after the last symptom has subsided he is fairly safe. If in the X ray there are evidences of rarefied pockets or cavity formation or areas of extreme osteoporosis the case is unfavorable but if the bone structure appears

fairly uniform arthroplasty should be successful.

It is needless to emphasize the fact that improvised tendinous grafts to take the place of the patella are certainly not as desirable as the retention of the patella at the arthrodesis operation for later utilization in arthroplasty.

For a long time in a large number of cases I have preserved the patella as a pedicle graft mortised or brought it in contact with both tibia and femur to increase osteogenesis and the results have been excellent so far as the arthrodesis was concerned. Now since the new concept of preserving the patella for use in a future arthroplasty has appealed to me if the patella is involved in the infection I remove only the small diseased portion the remainder being allowed to remain *in situ* for future utilization.

In Table II are listed the end results in 24 cases of arthroplasty on tuberculous knees which have been reported in the literature and my case which has already been described and in which the result was excellent. I have also done an arthroplasty in several cases of healed tuberculosis of the hip with good results.

*The position of ankylosis.* Extreme flexion is unfavorable to arthroplasty because it makes the technique very difficult and

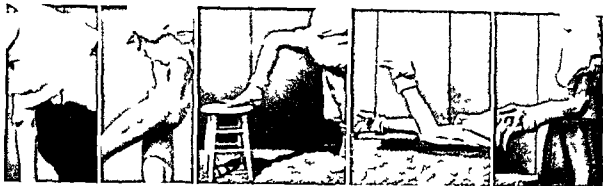


Fig. 1. Weight bearing. Fig. 2. Incision. Fig. 3. Flexion. Fig. 4. Extension. Fig. 5. Flexion. Fig. 6. Extension.

necessitate extensive removal of bone and the sacrifice of that portion of the tibia and femur which has the large diameter thus tending to produce lateral instability. If the knee is markedly flexed it is advisable to perform a preliminary supracondylar osteotomy.

The condition of neighboring joints should also be considered. If both knee are ankylosed arthroplasty on one is definitely indicated or if the knee and hip on the same side are ankylosed there should be slight reason for hesitation.

To women the awkwardness of ankylosis is more annoying than to men and in young women ankylosis often proves a distinct handicap socially. For both men and women the nature of their profession or occupation will often determine how essential mobility of the knee is to them.

Five years ago I would have said that ankylosis in extension was best left alone but in view of the constantly improving results from arthroplasty I believe that the patient should be given the benefit of the latter unless there are definite contra indications.

**Co operation of the patient.** In few operations is the absolute co operation of the patient so essential as in arthroplasty of the knee. However perfectly the technique may be executed a good functional result cannot be obtained unless the patient submits with patience, courage and intelligence to the long postoperative treatment which is likely to be both painful in the first stages and is always tedious. It is wise to test the patient's

nervous stability by telling him this in advance and to let his reaction to such a statement be an indication for or against the operation.

All persons of weak will those of excessive nervous instability and those who have a litigation interest in not getting better such as certain compensation and accident cases must be eliminated if the surgeon does not wish to risk unnecessary failures.

Age and sex are not vital factors although patients under 16 years are sometimes difficult to manage after operation and those over 50 years have not the same degree of resistance. It has been stated by some authors that men are more favorable subjects than women but this has not been my experience.

**Incision.** The incision should satisfy two conditions (1) give free access to the most remote corner of the joint so that it may be meticulously modelled and bony debris cleared out and (2) preserve the juxtaparticular elements particularly the extensor apparatus above the knee which is so important for future active mobility and stability.

Three types of incision are to be considered (1) the lateral incisions used by Murphy and Baer (2) the U incision with concavity downward and the inverted U incision with concavity upward. The lateral incisions avoid severance of the quadriceps but do not afford free access to the joint particularly to the popliteal space are apt to lead to necrosis of the soft parts due to the trauma from difficult instrumental retraction and because

of the severing or traumatizing of the soft parts above the knee may impair the extensor apparatus which is so essential to motion. Murphy for a time abandoned this method for the U incision but later returned to the lateral incisions. They are now rarely used except by Baer.

The inverted U incision advocated by several authors including Putti and popular in France is also objectionable in that it severs the extensor apparatus lying above the joint entails suture of these soft parts and the possibility of slow union which will delay postoperative physiotherapy and further adhesions in this location will interfere with the free gliding of the extensor apparatus which is as important as motion in the joint itself.

The U incision with concavity upward is the incision of choice since it affords free access to the joint and does not disturb the important extensor apparatus above it and especially since the only objection to this incision can be removed by the simple dovetail osteoplastic method of turning upward the ligamentum patellæ as employed by the author.

*Treatment of the quadriceps.* In many instances that part of the knee joint which extends above and posterior to the quadriceps tendon has not been seriously diseased and the quadriceps tendon and muscle are neither shortened nor adherent to the lower end of the femur. In this event the excursion of the extensor apparatus is sufficiently intact so that no plastic work is necessary. In the event however of adhesions scar tissue or shortening of the quadriceps tendon and muscle they must be overcome by plastic methods and lastly it may entail the implantation of an extensive fat and fascia graft between the quadriceps tendon and femur.

If my method of approach is used it is not necessary to lengthen the quadriceps routinely and I recommend against it as it interferes with the extensor apparatus.

*Treatment of the ligamentum patellæ.* This point has already been discussed in detail under Author's technique. The cutting of the ligament and later the suturing of it as done by some surgeons has obvious serious

TABLE II—END RESULTS OF ARTHROPLASTY ON BONY ANKYLOSED KNEES OF TUBERCULOUS ORIGIN

A the Albee	C	R	lis	flexion	full
	1	Excellent	90 active	extension	lateral in
Baer (6 on fibrous ankylosis of tuberculosis or origin)	1	Good	55		
Ceballos	2	(0 to 75 motion)			
Delbet	1	1 good result			
		1 instula and re ankylosis			Patient
		1 did not co operate			failure
Diel	1	Improved			
Le Fort	1	Good			
Henderson	2	Unsatisfactory			
Hintz	1	Unsatisfactory			
Hubscher	1	Patella mobile	30	flexion	
In ebron sten	1	Good			
Leriche		1 good			
		1 slight lateral mobility		some re	
		traction of quadriceps			
Payr		5 flexion			
		Excellent (80 to 90 flexion)			
Putti	0				
Roth		1 satisfactory		Can get on tramway	
		1—at end of 3 months	60	passive	
		flexion	40	active	
Serada		1 after operation		good mobility	
		but genu valgum developed			
		which was treated by immobilization			
		When apparatus was removed			
		knee was re ankylosed			
		1 failure—suppuration			
Tubby	1	Failure			
Wieting	3	Good			
Total	24	11	good results		

Campbell, Putti and Lever consider tuberculosis a definite contra indication to arthroplasty. Murphy an unfavorable factor but not a contra indication. Henderson advises great conservatism. Payr and Baer consider healed tuberculous case properly selected favorable. The author concurs with the latter opinion.

disadvantages in that the union of tendon to tendon is at best slow and not always firm. If the tibial tuberosity is taken with the ligament the means of fixing it in place after it has been reimplanted have usually involved the use of foreign bodies such as nails or screws which are ill advised. The author's method of dovetail cabinet maker's fit made possible by motor instruments has already been described. This method requires no foreign bodies for fixation purposes and insures early union. Although I worked out this method independently I find on reviewing the literature that Kirschner proposed in 1910 a similar method. The criticism has been

made in the literature that by Kirschner's method the mortising may not be sufficiently accurate or firm and a fracture or pulling away may occur during the postoperative treatment. With the use of the motorsaw drill and gigli saw this possibility is entirely eliminated for the work can be done quickly and easily and the cabinet maker's dove tailed fit assures firm attachment or union before postoperative treatment is begun. The method is strongly recommended as being distinctly preferable to the alternative—sectioning the quadriceps.

*Freeing of the patella.* With the chisel the patella is detached from the femur the procedures described in the literature varying with the type of skin incision half from without and half from within if two lateral incisions are used from below upward if the U incision is used and from above downward in Putt's new procedure the inverted U incision Ceballos vertical hemisection of the patella and quadriceps is rather too complicated as the instruments must be inserted through the breach in the quadriceps. I advocate turning the patella upward because this does not traumatize the extensor apparatus above the patella.

*Cleaning of the freed joint* must be most painstaking with removal of all fibrous elements. In old bony ankyloses often no vestige of the menisci is found nor of the crucial ligaments which have become absorbed in the ankylosis. The capsule presents itself as an indistinct and adherent mass. The lateral ligaments may exist as cords or bands very difficult to isolate. Very often they are shortened and if not sacrificed during the breaking up of the ankylosis they limit the separation of the surfaces. Many authors notably Ogilvy and Ceballos recommend preserving them. Others considering that they oppose thorough exploration particularly of the popliteal space resect them more or less completely if not entirely. Knowing the importance of these ligaments as regards stability of the joint one seems caught in a dilemma either the ligaments must be sacrificed to make a complete exposure and to obviate the possibility of re ankylosis with the risk that lateral mobility be taken or in order to

insure stability the ligaments may be preserved at any price with the danger that condylar bony bridges or fibrous masses remaining in the popliteal space may induce shortening and favor re ankylosis. Payr chooses a medium course he divides the ligaments after freeing them from all cicatricial tissue. The anterior half is detached from the tibia the posterior from the femur. Both are then turned toward their insertion and detached from the adjacent meniscus.

I believe that it is not best to lay down any rule but to conserve the ligaments whenever possible. If necessary however one should not hesitate to sacrifice them in order to get a good exposure particularly as the concave and convex wedge shaped modelling of the tibia and femur will practically insure stability. If the lateral approach is used the lateral ligaments may undoubtedly interfere with adequate exposure but with the U incision which I use as do several other surgeons they can usually be entirely preserved and sufficient bone removed to allow free motion and adequate space to receive the graft implantation.

*Modelling the osseous surfaces.* This is a very important stage of the operation. Most authors recommend imitating the normal joint contour so far as possible at once simplifying and exaggerating it and also taking care that the transverse diameter is not made too short as this will interfere with stability. Payr makes a convex concave modeling 1 centimeter deep in the center and from 2 to 5 centimeters in front and in back. That is to say the convex inferior extremity of the femur will have a smaller radius than the concave superior extremity of the tibia. He also hollows out a deep groove for the patella so that its shoulder impinging on the edge of this assures lateral stability of the joint.

I largely ignore the normal contour and use the convex and concave wide V shaped modelling already described which has afforded satisfactory mobility and lateral stability in every case.

Those who attempt to approximate the contour of the normal joint use curved instruments but for the wedge shaped modelling the ordinary broad osteotome is used. Inas-

much as this technique works along straight lines rather than complicated curved ones it is simpler to execute.

Various methods for securing lateral stability are suggested in the literature. Prevention of the maximum transverse diameter of the epiphyses painstaking care to insure a perfect fit of the articular surfaces. If it is remembered that in the normal knee congruence between the bony surfaces does not exist but is effected only by the fibrocartilaginous menisci and that these have been destroyed or absorbed by the ankylosis or extirpated by the surgeon we readily realize that it is necessary to establish between the bony surfaces themselves a most perfect fit. If an attempt to imitate the normal contour is made the femoral condyle and the corresponding tibial surface should be modelled with the same gouge to assure a similar curve (Putti's method). One tibial surface may be separated from the other by an anteroposterior ridge opposite which a deep groove is hollowed out between the condyles. To facilitate gliding movements in the ankylosis it has been suggested that the anteroposterior diameter of the condyles be diminished and their posterior projection shortened particularly the condyles of the femur which might form bone block to flexion.

Whether the author's wide V shaped modelling or the more complicated attempt to imitate the normal is used accuracy of fit and wide diameters are essential to success. Arthroplasty is by no means an easy operation and should be attempted only by those skilled in bone surgery.

The patella frequently hypertrophied and often to enormous proportions must be reduced sometimes to one half its size. Its posterior surface is conformed like a donkey's back. Cuneo believes that reduction in the size of the patella is a means of getting a certain laxity of the patella-quadriceps apparatus.

*The material for interposition.* The evolution of the material used for interposition is interesting—from the early use of foreign bodies to the present introduction of organic tissue the most favored being free autogenous fascia lata and fat grafts. The inadvisability of using

foreign bodies was discovered when the technique of arthroplasties in other joints was being developed. A variety of substances such as wood, gold, aluminum, iodoform gauze, paraffin, gummed taffeta, celluloid, silver rubber and batiste had been employed. The harder materials became fragmented or displaced, the pliable ones wrinkled and folded and all were a frequent source of infection.

Then Murphy introduced the use of the pedicled flap of fascia and fat and from this has gradually come the free fascia and fat flap taken from the thigh either of the same or the opposite leg. In arthroplasty of the knee the pedicled graft is many times not favorable material in that it may contain some scar tissue or some of the old inflammatory processes. Also the pedicle produces unfavorable conditions where it comes through the periphery of the joint. MacAusland recommends taking the graft from the opposite leg and I believe that the point is well taken in that it eliminates trauma to the soft tissues above the knee, the importance of which in function has already been emphasized.

Baer uses the submucosa of the pig's bladder specially prepared and known as Baer's membrane. Whereas he has reported good results from this method in fibrous ankylosis they are not good for bony ankylosis. Other surgeons who have tried the method report many failures.

Allison and Brooks experimented with Cargyle's membrane, free fascia from the fascia lata, pedunculated fascia flaps, chromicized pig's bladder (Baer) and fascia impregnated with silver to determine the possibility of the interposed substance healing in the length of time it may persist, the amount of reaction it produces and its efficiency as a factor in the restoration of an anatomical articulation. It was found that Cargyle's membrane persisted between the opposed joint surfaces only for a few days and did not prevent the adhesion of the opposed joint surfaces. Chromicized pig's bladder persisted for a longer time but the reaction of the surrounding tissues was of such intensity that even at the time the membrane was disintegrating there were adhesions between the granulating surfaces.



Allison and Brooks recommend the use of silver impregnated fascia since they found that this prevented the union of the denuded joint surfaces better than did free fascia and did not cause any marked local reaction. But silver is a foreign body and will stimulate tissue reaction. Nature's effort either to encapsulate it or to throw it off means overproduction of tissue which is exactly what is not desired. In arthroplasty there should be the least possible amount of tissue reaction. The inclusion of fat with the fascia certainly the living autogenous fascia and fat graft unimpregnated stimulates less reaction than anything else possibly could. This is a fundamental.

Certain essentials must be met by the material of interposition if the arthroplasty is to be satisfactory. (1) it must be resistant to puncture. (2) if possible it should be of semi fluid consistency and sufficiently thick at certain points to fill all the crevices in the new formed joint. (3) it must be pliable so that it will adapt itself to the contours of the joint. (4) it must set up a minimum of tissue reaction since such reaction is likely to develop into adhesions or excessive exudate with the possibility of establishing a sinus outward. (5) it should remain unabsorbed for 30 to 40 days in order to limit osteogenesis and (6) it must be sterile.

In meeting these requirements the autogenous fascia and fat graft stands out in a class by itself. The first two requirements are especially fulfilled by the combination of fascia lata and fat in that the dense tough fascia lata resists puncture or penetration from bone pressure immediately following operation when the patient's muscles go into involuntary spasm and also later during postoperative physiotherapy. The fat being semi fluid answers the second requirement as fascia lata alone cannot do. It is for this reason that I firmly believe that fat should be included in the graft.

Once the graft is in place it is attached to the periosteum and to the adjacent structures by a continuous suture of No. 1 chromic catgut.

**Closure.** The closure of the joint should be meticulous. Care should be taken to leave

the skin flap overlying interior work as thick as possible continuous suture of No. 1 chromic catgut being used to close the subcutaneous tissues and continuous suture of No. 1 plain catgut for the skin. The object being to get immediate union and a sufficient thickness of tissue at the line of suture so that it will not break down following the operation. The tourniquet should be left on until the plaster cast has been applied from below up to it. This method of guarding against the formation of hematoma has already been discussed under Author's technique.

**Postoperative traction, weight bearing and physiotherapy.** Continuous traction on the new joint and early voluntary movements are the essentials of after treatment. As has already been stated the traction is continued for at least 1½ months after the plaster is removed and is maintained at nights after the patient begins to walk with crutches but without weight bearing. Weight bearing is not permitted until at least 3 months after the operation.

The first difficulty which the physiotherapist has to overcome is fear on the part of the patient. The parts involved in the postoperative treatment are so extensive and the muscles so powerful that if these are in a state of spasm the physiotherapist can make no progress. Obviously every particle of fear must be allayed in order to relieve this spasm. Since the absolute confidence of the patient is the first step gentleness must be used at first but not too long for unless rapid progress is made adhesions may develop and seriously retard if not impair the end result. For that reason consistent work coordinated with the mental with the physical should be carried on daily for the first 4 weeks at least. Patients are sent home from these treatments with the feeling that use is not going to produce pain but with instructions to give the joint perfect rest between treatments at first to use hot applications or sit in a hot tub soon after they get home. A little later they are taught how to do supplementary massage at home between treatments then to harness the leg over the edge of the bed and finally to use it but not to the extent of producing pain.

## SECONDARY OPERATIONS

If at the end of 3 to 6 months lateral mobility persists Hey Groves recommends a second operation to reinforce lateral ligaments. This has not been found necessary with the author's technique as in every case the joint has had most satisfactory lateral stability. But I have in several cases done secondary operations to sever restricting bands of fascia or scar tissue lateral to or above the patella which were limiting mobility and the results have been excellent (Cases 2, 3 and 7).

These operations have varied in degree from a short incision and the severance of a small band or two of fascia or connective tissue to an extensive operation where even the new formed joint has been unintentionally entered and extensive soft parts severed.

We believe that this is a rather radical step that has not been practiced by other men and personally I feel very enthusiastic about secondary operations to overcome tissue contractions interfering with motion. Case 2 (M. K.) is a striking example of what may be accomplished by secondary operation.

## PLANNING ARTHRODESIS WITH VIEW TO FUTURE ARTHROPLASTY

Arthroplastic operations on the knee are becoming so satisfactory and the prognosis so favorable that one should certainly plan arthrodeses so that a future arthroplasty for mobility may be done under as favorable conditions as possible. For whatever cause an arthrodesis may be undertaken it is important that the patella be left *in situ* in the quadriceps tendon because of the possibility of future arthroplasty.

Röntgenograms (Figs. 3 and 4) are shown of a typical case illustrating the author's method of arthrodesis which is so planned as to establish the best condition for a future arthroplasty. Case 3 (E. T.) is a striking example of the wisdom of such a procedure as the patient returned several years later with an urgent request for arthroplasty.

## EVOLUTION OF NEARTHROSES

If it is true that a knee which at the end of 3 months has a mobility of 30 degrees will go

on increasing the degree of excursion it is certain that an excised capsule reforms and with it ligamentous cords reform at useful points it must be emphasized that all these processes progress extremely slowly. The nearthrosis is formed in the midst of surrounding tissues just as the normal joint is formed in the mesenchyma of the embryo. If this genesis is slow in embryonic tissues it is even slower in the completely evolved tissues of the adult. Sudhoff had the opportunity to examine an elbow operated on 2 years before by Payr. He found histological phenomena showing that the articular tissues had not yet reached a stable definite structure.

Pain does not usually persist after the first series of postoperative treatment. Soon the epiphyses correctly modelled become painless.

The motor muscles gradually regain their ability to contract even if they have been inactive for years. The reflexes reappear. The different types of sensation—superficial and deep baræsthesia and sensation of position—are at length reestablished as in a normal knee.

The nearthroses possess still another characteristic once established—they are never the seat of effusion or of swelling. They seem to be resistant to all hæmatogenous arthritic processes. One of Payr's patients a cavalry officer of the late war fell from an aeroplane and his leg was immobilized for several months for an infected fracture of the femur on the side operated upon yet the arthroplastic knee retained all its mobility.

The artificial joint created by the surgeon to relieve ankylosis is by no means a normal joint. It suffices that there is a joint which functions well.

## RADIOGRAPHIC APPEARANCE

From the point of view of radiography a knee which has been mobilized by arthroplasty for some time has a strong resemblance to chronic arthritis. The surfaces are not exactly plane nor is the interline exactly linear. Free bony formations are frequently observed in the cavity. However proliferative phenomena are not always lacking. Their appearance as in a case of Mauclairé in which

osteophytes arose on the borders of the interline determined re ankylosis

#### METROTHERAPY

During the postoperative treatment it is often encouraging to the patient to let him observe the progress of function by means of metrotherapy apparatus described by Gilliland and the author in 1920. Metrotherapy is a means of demonstrating to the patient just what effect treatment is producing. By means of accurate measurements of the amplitude strength and rapidity of voluntary movement of the impaired joint the patient is shown the nature and the rate of his recovery. One of its greatest values lies in its psychologic effect on the man in interesting him in the progress of his own case. Even a small gain is most encouraging and the patient is urged to try to beat his former records. These factors induce a maximum of voluntary effort and create a healthy interest in the mind of the patient.

#### SUMMARY

The prognosis for arthroplasty of the knee to relieve bony ankylosis has distinctly improved owing to refinements of technique and a better understanding of the indications and selection of cases. The author presents certain original features notably a wedge-shaped modelling of the joint which eliminates the danger of lateral stability and yet affords adequate mobility. Tuberculosis is not necessarily a contra indication if the infection has been quiescent for a number of years. Such cases should be approached with conservatism but not with pessimism and careful X-ray studies are helpful in making the final decision. In arthroplasty the steps following operation are almost as important as the surgery. Without them and without the full co-operation of the patient a perfect surgical operation may be followed by a functional failure. Ten cases which were operated on by the author with good functional result are reported.

Arthroplasty of the knee has as yet no standard technique. It is still an open chapter in joint surgery and one which offers much promise.

Although the prognosis has definitely improved the operation is by no means an easy one and should be attempted only by the skilled in bone plastic surgery and thoroughly familiar with the principles governing after care.

#### AUTHOR'S CASES

**CASE 1.** Mr R. E. aged 15 years. The patient had a double mastoid with very virulent streptococcus infection and dissection was made even as far forward as under the muscle planes of his face on one side. This was followed by a metastatic infection in the knee joint of a very severe suppurative type. Repeated aspirations were carried on to no avail. In fact the septic process increased in virulence. Extensive drainage laterally on both sides was instituted but still without control of the infection.

An uncle was immunized with vaccines from the cultures made from the patient's knee and the patient was transfused from this uncle on two occasions with a very satisfactory result. The supuration of the knee gradually subsided and finally healed but it left the joint completely ankylosed in extension with bony union of tibia to femur and femur to patella.

Arthroplasty by means of the technique already described was performed July 12, 1929. Dressings were removed August 30. September 3 the wound was entirely healed and the patient had 15 degrees of active flexion. X-ray pictures showed a satisfactory new formed joint. Weights at night were continued and no weight bearing permitted but massage and graded exercises begun. October 21 motion was still increasing and after a forcible manipulation under anesthesia to break and sever restraining bands the progress was uneventful.

At present there is 85 degrees of active flexion. Function is most satisfactory as shown by the fact that the patient has recently won a swimming race and enjoys other athletic pursuits.

**CASE 2.** Miss E. F. 17 years of age. At 17 months the patient fell from her chair and the right knee became stiff following this accident. At the age of 15 she was brought to the author because of pain and stiffness in this knee which had previously been treated elsewhere by plaster cast and braces.

X-ray examination revealed a tuberculous process with extensive destruction of the joint. Arthrodesis was performed by the author in October 1929 with the knee in 10 to 15 degrees of flexion.

Following this operation the patient and her parents made repeated and persistent requests for an operation to produce mobility until in May 1934 much against his own desire and judgment the author did an arthroplasty and applied traction as described under technique. Except for a slight discharge from superficial structures the recovery was uneventful and massage and exercises were

begun traction being continued until 2 months after operation. In the latter part of August the patient had slight motion and this consistently increased until in December the result was good except for some limitation of motion which seemed to be due to adhesions.

In February 1925 the knee was manipulated under gas to break up adhesions around the patella and this manipulation was repeated in May. Exercises and massage were continued until the excellent result shown in Figures 9, 10 and 11 was obtained. From the beginning there had been no lateral instability.

In September 1927 the patient who had had 80 degrees of active flexion for some time happened to meet another of my patients who had a slightly superior result and she requested a secondary operation. As she expressed it she felt some restriction at the inner aspect of the joint which she was not conscious of on the outer aspect and believed if this restriction could be overcome she would have a perfect result.

This secondary operation was done September 19, 1927 and consisted of parallel skin incisions on either side of the quadriceps tendon just above the patella and severance of all soft structures which were restricting flexion. The new formed joint was unintentionally entered at the outer incision but by dissecting up the new formed capsule or joint membrane it was possible to secure a favorable closure. Fat tissue was dissected away from beneath the skin on the outer side of the outer incision and on the inside of the inner incision and drawn into the clefts made while the leg was in extreme flexion. The skin was closed in the usual manner.

The knee was put up in flexion of 110 degrees and that position maintained in plaster for one week after which the cast was removed and 15 pounds of traction applied to bring the leg into full extension again. Massage and exercises were begun at this time but traction at night continued. Later the patient was allowed to walk with crutches without weight bearing. At the present writing the patient is bearing weight walking without cane or crutch.

CASE 3 Miss M. K. 18 years of age. Patient had bony ankylosis of the right knee following a pronounced osteomyelitis of 3 years duration. The wound healed for 2 months when patient consulted author in December 1925. The knee was fixed in 10 degrees of flexion. Arthroplasty was performed December 15, 1925 and traction applied. Recovery was uneventful. Massage and exercises were begun February 8, 1926. March 19, 1926 the knee was manipulated under gas to a right angle of motion. This was repeated in August.

Although mobility constantly increased there still seemed to be constricting bands which prevented the patient from getting complete mobility. Therefore on January 19, 1927 a secondary open operation was performed and all soft parts and fascia lateral to the quadriceps tendon which were restricting flexion were severed. The knee was put

up in plaster in 120 degrees of flexion for one week. The plaster was then removed and 10 pounds of traction was applied to straighten the limb. Later massage and exercises were begun and gradually weight bearing permitted.

In November 1927 the result was excellent active extension was practically normal there was active flexion of 95 degrees and no lateral instability (Figures 12 to 16).

CASE 4 Mrs D. L. 33 years of age. In July 1920 after recovery from typhoid the patient fell and injured her right knee. A cast was applied for 3 months and when the cast was removed there was complete bony ankylosis. The patient insisted on arthroplasty which was performed March 29, 1921. When last seen the progress was very satisfactory but we are unable to determine the ultimate result as a follow up letter was returned.

CASE 5 Mr D. H. 43 years of age. This is a case of arthroplasty. The right knee was injured in an automobile accident and was put up in a cast for 4 weeks. Eight weeks after the accident open drainage of the joint was instituted and a cast applied in a right angle of flexion for 12 days. The patient consulted the author one year after the accident on account of bony ankylosis in full extension. Arthroplasty was performed in February 1925.

A letter from the patient October 31, 1927 reads: "I have more than a right angle of flexion and the extension is about normal. There is nothing in my walk to indicate there ever was anything wrong. I ride horseback, play tennis and in every other way lead a normal physical life."

CASE 6 Mr J. W. C. 36 years of age was injured in an automobile accident and subsequently had a pyæmic infection of the knee joint. Three open operations had been performed resulting in complete bony ankylosis in 15 to 20 degrees of flexion.

The patient consulted the author August 24, 1926 and arthroplasty was performed September 30. The end result was satisfactory active extension was practically normal active flexion to 85 degrees and there was no lateral instability.

CASE 7 Miss A. M. 23 years of age. An acute osteomyelitis of the left tibia with metastatic infection to hip, knee and ankle led to complete bony ankylosis of the hip and knee and partial or fibrous ankylosis of the ankle. The knee was ankylosed in from 50 to 20 degrees flexion.

When the patient consulted the author the ankylosis had existed for 3 years. Arthroplasty was performed February 11, 1926 and traction was immediately applied. Postoperative treatment as described was carried out. Manipulation under gas was carried out April 17, 1926 to increase the range of motion. June 7, 1926 a secondary operation was performed to sever a band of fascia which was restricting motion. The patient now has 80 degrees of active flexion, normal active extension and lateral stability.



## AUTOTRANSPLANTATION OF ENDOMETRIUM IN THE EYE OF RABBITS

By EDWARD ALLEN, M.D., F.A.C.S. AND CARL P. BAUER, M.D. CHICAGO  
F m th D p tm t f Ob t t d Gyn l gy R h m d I C ll g Ch c g

**A**UTOTRANSPLANTATION of endometrium in the ordinary laboratory animals lends itself to many interesting and instructive problems as applied to the human female. Interpretation of some of the results are however more difficult because of differences in the cyclic changes of estrus and menstruation as well as in the structure of the endometrium itself. Many investigations have shown the comparative ease with which endometrial tissue will take when transplanted to distant points in the abdominal cavity.

Following the advancement of the now widely accepted transplantation theory of Sampson (10) his co worker Jacobson (6) reported the production of epithelium lined cysts by autotransplantation of bits of endometrium into different places in the pelvis and abdominal cavity of rabbits. Later Jacobson (7) repeated this work using monkeys. In this series the survival of the implant was not quite so constant but the bleeding which occurred in at least one of these endometrium like cysts seemed to be very much like that occurring in similar growths in women.

Several years before Jacobson's work Stilling (11) also working with rabbits was able consistently to implant pieces of vagina, uterus and endometrium into the spleen and produce cysts of various sizes which were lined with ciliated columnar epithelium. These cysts contained secretion under tension yet the epithelium often piled up in papillary outgrowths. The wall of these cysts would also regenerate after a piece had been removed for section.

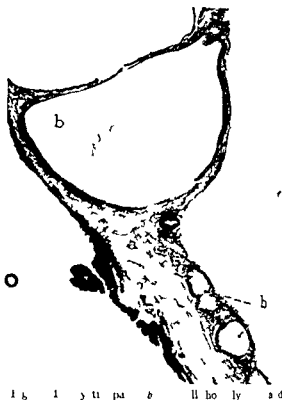
Hesselberg, Kerwin and Loeb (5) transplanted kidney, thyroid, uterus and endometrium in guinea pigs. They found that about 3 days after implantation regeneration of the cells which had become necrotic since removal began and at 5 days a firm attachment to the host had occurred. This attached tissue formed cysts with a retention of the

uterine epithelium but little of the uterine musculature. Mitotic figures were much more common in the uterine epithelial cells than in the kidney and thyroid tissue indicating that the epithelium of the endometrium was more responsive to proliferative stimuli.

The experimental work of Bykow (1) in which he transplanted the entire uterus of young dogs to the omentum would also indicate that the endometrium has greater tendencies of proliferation than the uterine muscle or its supporting connective tissue. In the 4 animals which he used in this work the transplanted uterus showed a development into the adult type of cell but only the endometrium exposed by amputation revealed a tendency to active proliferation.

O'Keefe and Crossen (9) report 5 successful implantations in a series of 10 dogs. All of these implants were transferred to the region of the appendix except one which was introduced into the ovary. The most characteristic finding in this group seemed to be the dense adhesions formed about the implantation site. This is also a constant finding in the ectopic endometrial growths in women.

Much discussion has arisen concerning the advisability of castration in the treatment of advanced human endometriosis. The work of Katz and Szenes (8) would indicate that the proliferation of epithelium and cyst formation at least in these transplanted bits of endometrium is dependent on ovarian function. It occurred to us that further observations might be made if we could implant pieces of endometrium in a location where the changes from day to day could be observed. The interior chamber of the eye seemed to fill most of these requirements, viz. visibility, circulation, fixation and the ease with which the implant could be recovered for microscopic study. Not only is the vascularization of the eye sufficient but just as soon as the tissue is slipped beneath the



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corner it is bathed in a circulating fluid that should maintain vitality and promote growth

#### METHOD

In this experiment 5 rabbit were used Under ether anesthesia the abdomen was opened by a midline incision Small portions or all of the uteri were removed placed in warm normal salt solution and as soon as possible small pieces were implanted in the anterior chamber of each eye Small bits of testicular tissue were implanted in the eyes of 4 of these rabbit for a comparative check on growth and reaction With a little practice we found that we could readily insert pieces up to the size of a split pea After the abdomen was closed a small piece of tissue was implanted in the abdominal incision of each animal

The eye were first prepared by clipping the lid hair short with ordinary finger nail scissors A drop of mercurochrome dropped into each eye furnished enough fluid for the easy handling of the implant With the eye

fixed and slightly rotated an incision was made through the cornea at the limbus with an ordinary cataract knife Sufficient fluid usually escaped so that the intra ocular tension was decreased enough to allow the implant to be easily inserted into the anterior chamber on the end of a blunt eye spatula In the beginning we closed the lids by a single interrupted suture for the first 48 hours but later better results were obtained by leaving the eye open without any form of dressing

#### RESULTS

No attempt will be made to describe the progress of growth or microscopic findings in the separate animals except those that showed unusual conditions We shall try to give a composite picture of the course of growth gross and microscopic pathology of this group of specimens and the conclusions we draw from them

A successful take was obtained in 44 of the 50 eyes The eyes were either enucleated separately or when the last one was to be

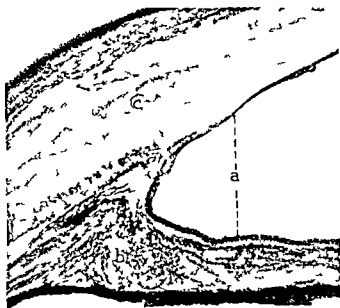


Fig 3 The ciliated columnar epithelium *a* can be seen spreading outward over the anterior surface of the iris *b* and extending on to the posterior surface of the cornea *c*

removed the animal was killed with ether and an autopsy performed. The eyes were fixed in Zenker's solution and sectioned in celloidin. The time of removal varied from 2 to 14 months.

In from 1 to 24 hours after the tissue was implanted in the anterior chamber the eye showed a marked reaction as from a foreign body. There was a profuse secretion. The conjunctiva was congested and photophobia seemed to be present. A marked congestion of all the vessels at the limbus took place. In about half the eyes the fluid of the anterior chamber became somewhat turbid. Usually this acute reaction had subsided by the sixth or eighth day. Definite dilated blood vessels could now be seen centering about and entering into the substance of the implant.

During the next 2 or 3 weeks there was a gradually increasing keratoconus and glaucoma in about 90 per cent of all the eyes containing uterine tissue. This keratoconus sometimes reached surprising proportions. In a few of the eyes the intraocular pressure became so pronounced that the cornea broke down at its apex, ulcerated, and the eye had to be enucleated to prevent infection. In one case (Fig 1) the implant with the iris attached was forced through the break in the cornea.



Fig 4 (left) The invading glands *a* are shown here quite definitely deep in the stroma of the iris *b*

Fig 5 Epithelial lined glands *a* in this section appear in the substance of the cornea *b*

During the next 4 weeks changes were noted which we were able to interpret only after some of the eyes had been sectioned. The most common finding was the appearance of cystic spaces varying from pinhead size to about 5 millimeters in diameter. The microscopic structure of these epithelium lined cysts is well illustrated in Figure 4. These cystic collections did not seem to increase in size or cause any abnormal reaction.

Less frequently we noticed a patchy deepening of the pigmentation of the iris. These thickened darkened areas spread from the base of the implant outward in irregular patterns. Microscopically these areas seemed to correspond with the active layer of epithelial cells which had covered over the anterior surface of the iris from the pupil to the angle with the cornea (Fig 3). This epithelium was directly continuous with and similar to that covering and contained in the glands of the transplant. In those portions nearest the implant it was high columnar and ciliated. At the periphery the cells were more often cuboidal. In many places budding or bleb formation was present as if cilia were being formed.

Many times this epithelium seemed to have a tendency toward the formation of glandular structures resembling the original endometrial glands. Most often this occurred on the anterior surface of the iris. In only a few





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in tances did the gland like structure appear to be invading the stroma of the iris (Fig. 3 and 4). That the c were probably not in invaginations of the epithelium following irregularities of the surface of the iris seemed to be indicated by the beginning of the formation of like spaces in the mouth under surface of the corner (Fig. 5). Quite frequently gland like mechanisms were present in the angle of the anterior chamber (Fig. 6). However these were most probably formed by the attachment of the iris to the under surface of the cornea.

Fischer (4) and Ibeling (5) have shown experimentally in tissue culture that epithelium has the ability to form a delicate continuous layer over the surface of artificial media. They were also able to demonstrate that epithelial cells have the property of assuming tubular arrangements which resemble glands.

In human endometriosis the question always confronts us as to the origin of the stroma which is found surrounding the islands of ectopic endometrial glands. It would seem that since the stroma of the endometrium is vital embryonic connective tissue its rate of growth or at least its proliferative tendencies would be greater than that of epithelial cells under the same conditions. In tissue culture Carrel (6) has shown that under given surroundings fibroblasts proliferate much more rapidly and eventually will even stop

the growth of epithelial cells when grown in mixed culture. We were not able to identify any proliferative tendency of the endometrial stroma or uterine musculature in any of the specimens although relatively large amount of both were contained in all of these implants. It certainly would not seem that the stromal cells are a response to the ectopic presence of misplaced epithelial cells or that the stromal cells themselves have sufficient proliferative tendency to follow along with the outward extension of the epithelium.

In of these rabbits that became pregnant subsequently to the implantation we observed changes in the ectopic tissue which resemble those found in a section of the decidua vera (Figs. 7 and 8). There seems to be a definite swelling and edema of the stromal cells. The glands are more tortuous elongated and abundant.

The fact that the epithelium lined cyst mentioned did not increase in size would indicate a lack of secretory activity on the part of the epithelium. On the other hand the uniform increase in the intraocular pressure with the resultant keratoconus would suggest the possibility of secretory activity. Interference with equalization of pressure through the canal of Schlemm by means of the preadherent epithelium may be the most simple explanation and it so might offer material for study in the production of experimental glaucoma. Very definite microscopic evidence



ADULT HUMAN ENDOMETRIUM IN TISSUE CULTURE<sup>1</sup>

By HIRSHI F. HAUT, M.D., BALTIMORE, MARYLAND  
 F m h (y) I H e p m f h j h H r k H I d U y

Our knowledge of the functions and interrelation of the female genital organs has been gained largely by clinical observation and by the use of pathological and physiological methods of study. Practically all our ideas concerning the relation of the ovary to the menstrual cycle have been gathered by use of the older histological methods together with seemingly logical deduction from animal experimentation. By these means a large number of generalizations have been made possible but we are still much in doubt as to the actual mechanisms by which the cyclical change are produced such as we see going on in the endometrium, ovary and other organs during the intermenstrual period.

Our idea bearing upon the relation of the ovary to the change which occur in the endometrium during the menstrual cycle are founded pretty largely upon the synchronous appearance of the graafian follicle followed by the corpus luteum and a seemingly consistent change in the endometrium together with observations of what occurs in the absence of ovarian change, absence of ovaries or suppression of their activity. Accurate information concerning the details of the changes has been withheld principally for the reason that thus far no method has sufficed for the close inspection of the various tissues concerned during the change and no method has allowed the isolation of the many complicating factor of importance. Realizing this and casting about for a new method of approach it was thought important to determine whether or not the tissue culture technique with its opportunities for observation and control could be applied to the problem.

Thus far the method of tissue culture has been confined almost entirely to the study of embryonic tissues because these are far more easily and satisfactorily grown. Adult tissues of any origin are more difficult of continuous cultivation than are those from young or embryonic organisms for the reason apparently that embryonic cells possess greater

ability to cause synthesis of protoplasm from the various types of media that have thus far been developed. But despite this fact it was hoped that if a method could be devised whereby adult human endometrial and ovarian cells could be cultured the facilities would be at hand which would overcome to a certain extent the difficulties that have hindered the accumulation of more detailed and specific information in this field. It would be valuable because the tissues could be watched continuously from hour to hour through all their changes and each experiment could be adequately controlled. It would also provide the possibility of varying the forces at work or of altering them completely.

Such a technique has been devised and human endometrium has been grown successfully after many fruitless attempts for as long as 60 days *in vitro*. Its principal features are identical with or are modifications of the technique which has been developed by Carrel (2, 3).

## TECHNIQUE

The endometrial tissues were secured from the uterine cavity of uteri freshly received from the operating room. While still warm and sterile the uterus was opened and a small portion of endometrium was removed and placed in warm sterile Ringer's solution. At the same time blocks were also cut from the endometrium for microscopical preparations. The sections gave information concerning the stage of the menstrual cycle and the presence or absence of infection.

The sterile endometrium was carefully washed in several changes of Ringer's solution to free it of all possible traces of blood. This step is quite important as was found by experience for traces of blood serum are very inhibitory to the growth of adult cell. The tissue was cut into very small fragments. These were transplanted into a medium composed of two parts, one part was solid and formed from a fibrinogen suspension and

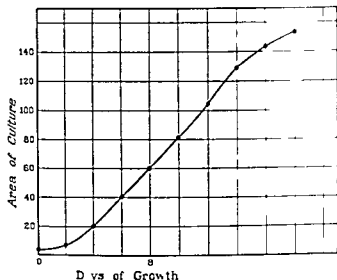


Fig. 1. The composite growth curve of 12 cultures of endometrial stroma cells of human endometrium. The initial period of 2 days in which little growth occurred. The rate of growth is approximately one half that of embryonic cells in the same media.

dilute embryonic extract containing a trace of sodium linoleate to prevent digestion of the clot the other part was fluid and was composed of tyrode solution. The fibrinogen suspension was introduced first being diluted with an equal volume of tyrode solution so that the whole volume was 1 cubic centimeter. Tyrode solution 0.5 cubic centimeter containing a trace of sodium linoleate and 0.5 cubic centimeter of dilute embryonic extract were then added. The fragments of endometrium were then carefully placed in the medium equidistant from one another before coagulation took place. The medium was then allowed to solidify and 1 cubic centimeter of tyrode solution was added. Before the implantation of the tissue was done the medium was carefully tested to determine the hydrogen ion concentration and the necessary modification made. The hydrogen ion concentration was maintained at approximately 7.2. The fluid medium was changed every day and replaced by fresh tyrode solution. The use of fibrinogen suspension as the source of the clot was adopted when it was found that the small traces of serum remaining in the clots formed from plasma was inhibitory even after repeated washings.

The rate of growth of the cultures was measured each 48 hours. They were placed in a projectoscope which cast a shadow of



Fig. 2. The edge of a culture of endometrial stroma cells. The culture is 14 days old. This culture was grown in a medium in which corpus luteum extract was substituted for embryonic tissue extract.

known magnification the shadow was outlined its area measured by means of a planimeter and the area computed and charted. The areas were plotted from day to day so that a growth curve for the various cultures was kept. In this way it was possible to ascertain with a good deal of accuracy the average rate of growth of the endometrial cells in the media used. This was found to be about half as fast as that of embryonic cells in the same media.

#### DESCRIPTION OF THE ENDOMETRIAL CULTURES

During the first 2 days following transplantation the explant increased only slightly in size. The following 7 days there was an increased rate of growth roughly twice that of the preceding period. Subsequently the rate of growth remained about the same there being an almost uniform increase in size. Accidents such as infection or liquefaction of the clot of course stopped growth or slowed it and such cultures were discarded. Figure 1 is a composite chart of 12 cultures and demonstrates graphically the rate of growth of the tissue.

At various stages cultures were fixed, stained and mounted for microscopic study. It was found that the growth occurred almost wholly from the stromal or connective tissue portions of the explant. The epithelial cells



Figure 3. A high power photomicrograph of an almost pure culture of epithelial cells obtained in a similar manner from a culture in which the stroma was absent and in which the epithelium survived and grew luxuriantly.

apparently had such a long latent period that they were overgrown by the stroma cell. This gave an almost pure tissue for inactive tissue cells on the periphery of the culture and by carefully sectioning a culture over to obtain only the peripheral cell we were able to obtain pure strain of stroma cell. Figure 4 is a culture grown from such an explant. Figure 5 is a high power photomicrograph of an almost pure culture of epithelial cells obtained in a similar manner from a culture in which the stroma was absent and in which the epithelium survived and grew luxuriantly.

#### EXPERIMENT

Being possessed of a pure culture of stroma cell which was grown at a known rate of growth in a media of known composition viz serum free fibrin clot embryonic extract and tyrode solution it seemed desirable to determine if possible what effect follicular fluid and an extract of corpus luteum cells would have on such a culture if used to replace the embryonic extract.

Follicular fluid was obtained from unruptured graafian follicles. These were found in freshly removed human ovaries from the operating room.

In a similar manner corpora lutea were obtained and an extract of the cells made in a manner exactly similar to that used for the preparation of the embryo extract. That is the corpora lutea were carefully dissected out of the ovary cut into small fragments and washed in numerous changes of sterile

langer's solution. The fragments were placed in a sterile Latapie apparatus crushed mixed with an equal volume of langer's solution and frozen and thawed twice to rupture the cell. Again an equal volume of Ringer's solution was added the mixture placed in centrifuge tube centrifugalized for 10 minutes and the supernatant fluid decanted. This constituted the corpus luteum extract used in the experiments.

An experiment consisted of three groups of 15 cultures each. All three groups had similar media with the exception that A had embryonic tissue juice, B had follicular fluid replacing the embryonic tissue juice and C had the corpus luteum extract replacing the embryonic extract all in similar volume.

The culture in B group survived 6 or 8 days with light cell migration but no real growth. Repeated experiments with greater volumes of the follicular fluid gave the same result.

The result was quite different in group C in which the corpus luteum extract was used in place of the embryonic extract. Here there was a most luxuriant and rapid growth of the cell equaling and in some instances exceeding the rate of growth in the culture containing the embryonic extract. Control consisting of culture in which ovarian stroma cell extract was used were not made. This was not considered necessary in the light of Drew's work (1) in which he found that adult cell did not grow in the absence of embryonic extract or in the absence of autolytic products which he thought were formed in the explant itself after several days of incubation. Obviously these experiments should be repeated with the ovarian stroma cells as controls to eliminate a possible source of mis-conception.

Figure 5 gives in the form of a graph the relative rate of growth in the three types of cultures. It will be seen at once that in this series of experiments 15 cultures to the group 45 to the experiment in the corpus luteum extract as made there are substances analogous to those contained in embryonic extract. That is there are substances present which enable the cells to metabolize some portion of the culture media into protoplasm and to reproduce themselves. That there are not the autolytic substances described by Drew

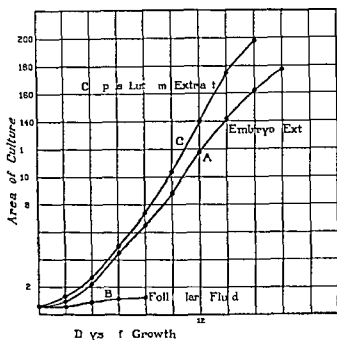


Fig. 5. A graph representing the composite growth curves of 3 series of cultures. Each series consisted of 15 cultures. They were similar except that 1 contained embryonic tissue extract, B contained follicular fluid, C contained corpus luteum extract.

seems certain as the extract was used fresh and was kept in an ice box. On the other hand it seems to be a much more stable substance than that contained in embryonic extract as temperatures up to 65 degrees C for 15 minutes did not affect its potency to any appreciable extent.

#### DISCUSSION

The question at once arises as to the nature of the substances present in the corpus luteum extract: is it similar to that contained in embryonic extract and is it the same substance which causes the cyclical changes in endometrium in the woman? The latter can not be answered at present. The former probably can be settled by further study.

Carrel and Baker (1) in a very brilliant series of experiments have demonstrated that fibroblasts in pure culture obtain the nitrogen from which they build protoplasm from proteoses and other primary derivatives of proteins. By splitting the protein molecule to various degrees they have obtained substances proteoses which are assimilated by the cells and metabolized to form protoplasm. They were able to produce this substance from a variety of sources. They replaced the



Fig. 4. An 18 day culture of stroma cells grown with corpus luteum extract. The dark group of cells (right) represents the original explant. There was liquefaction of the clot; hence the irregular outlines of the culture.

embryonic extract by solutions of proteoses in their tissue cultures and secured cellular response in the form of growth activity very closely paralleling that of their embryonic extract controls.

In view of their work which was published after this study was well advanced it is obviously necessary to repeat the corpus luteum extract experiments with extracts which have had careful nitrogen determinations to discover the degree to which the protein molecules in them may have been split before any definite conclusions can be drawn from this work. The work is presented at this time as a demonstration that the method is practical for the object in view and that in the near future physiological problems may be attacked by this method of study with the possibility that valuable information may be gleaned by its use. It is also a demonstration of the practicability of the use of adult tissues in this connection.

#### REFERENCES

1. CARREL and BAKER, *J. Exp. Med.* xlv 503.
2. CARREL, *J. Exp. Med.* xxxvi 407.
3. Idem, *Physiologic Reviews* vol. iv 1.
4. CROFT and CRY, *Am. J. Obst. & Gynec.* viii 645.
5. DREW, *Lancet* cciv 833.

## CHONDRODYSPLASIA

By MATTHEW CLEVELAND, M.D., NEW YORK  
 1 2 m h C l f h N Y k O r h p l D p y d h p l

**M**Y interest in chondrodysplasia was aroused by the presentation of a case by Cole (8) in 1926 which was almost the exact counterpart of a case we have had under observation at the New York Orthopaedic Dispensary.

The condition is generally considered to have been first described by Ollier (19) in 1899 as irregular growths of cartilage localized near the epiphyses of the long bone of one side of the body with resulting skeletal deformity. These cartilaginous masses adjacent to the epiphyses undergo delayed ossification which behavior differentiates them from multiple chondromata which never ossify. Ollier considered the condition to be quite distinct from achondroplasia with its more complete arrest of development but in his opinion it is not unlike rickets which results in overgrowth of cartilage at the epiphyses with subsequent ossification. He noted lesions in the phalanx of the fingers with resulting soft consistency allowing the phalanx to be pierced readily. Chondrodysplasia tends to heal spontaneously by replacement of cartilage with bone.

The disease described by Ollier was made the subject of a thesis by his pupil Molin (18) in 1900 who described 3 cases 2 of Ollier's and 1 of Nove-Josse and Destot's. He stated that the identity of dyschondroplasia and osteogenic exostosis needed further study. The salient features of the type of dyschondroplasia which he described may be stated as follows. It is an osseous dystrophy affecting the long bones of the extremities and the metacarpophalangeal skeleton with partial arrest of development and curvature of the long bones resulting. The diagnosis can be made by roentgenography. Its etiology is unknown and there are no microscopic or macroscopic observations on the disease. Molin's observations regarding the confusion existing between

chondrodysplasia or dyschondroplasia and multiple cartilaginous exostosis were timely and as a matter of fact the confusion of terms and conditions still persists.

Ihrenfried (10) reported 600 cases of hereditary deforming cartilaginous tumors under the title of Hereditary Deforming Chondrodysplasia. Among this large group less than 1 per cent showed marked asymmetry. Ahlurst (1) under the same title reported 11 cases that he had observed among others reporting cases of hereditary deforming cartilaginous tumors are Percy (21), Renfrew White (3), Campbell (6), Ord (20) and Levin (16). The latter recently recorded 6 cases and used the name suggested to Keith (14) and used by him diaphyseal aclasis. Keith (14) considers Ollier's type of chondrodysplasia only an extreme example of diaphyseal aclasis. His summary is as follows. The disease is known to clinicians as multiple exostosis, a definite disorder of growth and should be named diaphyseal aclasis to indicate the nature of the growth disturbance. It is congenital in point of origin and affects only those parts of the skeleton which are developed from both cartilage and membrane. It is related to chondroplasia and there is reason for suspecting that it may be due to a disturbance in the function of the gland of internal secretion, the thyroid gland being the one which is most likely to be at fault. The study of this disorder helps us to analyze the normal machinery of bone growth. While these multiple cartilaginous tumors may have something in common with Ollier's disease the clinical picture of the latter makes the few recorded cases fall into a discrete and definite little group from the clinical standpoint.

Coon (9) added a typical case in a child with the right upper and lower extremities involved showing lesions in the metatarsal and metacarpal of both sides of the body. He noted by roentgenogram of the long bones

Chondrodysplasia  
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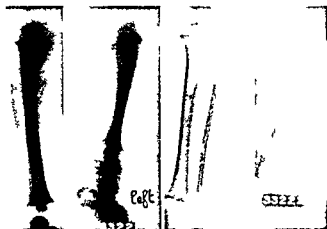


FIG. 1

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FIGS 1 2 and 3 Roentgenogram July 1930 The long bones of the left leg are short The distal inch of the tibia is enlarged and in this area there is a deficiency of bone structure apparently cartilaginous for the most part The bone is of coarse structure and appears in irregular strands and masses extending from the bony shaft into the cartilaginous portion The ossification is best developed posterior to the central axis of the mass and is absent at the periphery except for a flaring of the cortex of the shaft at the proximal end of the mass

There is no evidence of active destruction or effusion or infiltration The epiphysis is only slightly and irregularly ossified Similar changes are present at all the metaphyses of the long bones of the left leg except the proximal end of the fibula in the left side of the pelvis and in some of the left metatarsals The phalanges are not shown Where the epiphyseal line is visible it appears of normal width and the epiphyses are much less affected than the metaphyses

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Bentzon (2) in 1924 while reporting a case of Ollier's disease could find in the literature only 12 other similar cases His views which are of interest may be summarized Ollier's disease represents the typical reaction of the bones against certain disorders in the innervation of their blood vessels It is often confined to one half the body Masses of hyaline cartilage are found to follow paths similar to those of the arteries of the bones The pathological processes in the bone tissue may be assumed to be related to the formation of callus in a fracture where the blood vessels have been interrupted He disagrees with Ollier and Wittek (24) who described the dis-



FIG. 3

ease as a disturbance of epiphyseal growth He regards this as a secondary phenomenon The primary focus is he believes in the diaphyses which are nourished by a single large nutrient artery From an experimental standpoint working with rabbits he was able by interrupting the sympathetic nerves in some instances to produce structural changes in bone similar to those seen in Ollier's disease Bentzon's theories of the etiology of Ollier's disease supported by his studies form a valuable contribution

Voorhoeve ( ) presented cases of a brother and sister whose roentgenograms showed longitudinal striation of the metaphyses of the long bones and pelvis These manifestations he considered allied to chondrodysplasia but the symmetrical distribution places it outside the category of Ollier's disease A valuable list of references is found in his presentation

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*d bl h k h nd dy pl h p p*

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Fig. 1

Fig.

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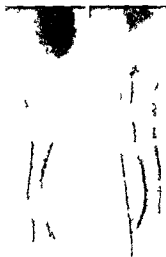


Fig 4



Fig 5



Fig 6

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Ollier's disease The pathological study of excised tissue showed cartilage cells of the myxomatous type

Cole has written very concisely on this disease giving summarized case reports on five patients besides his own a clear cut case of chondrodysplasia He concludes as follows

Fig 7

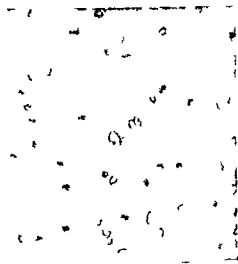


Fig 7

Fig 7 Photomicrograph of tissue from

1 Ollier's disease is a term which seems fixed in the literature but which should be used only to designate those cases of cartilaginous dystrophy with or without cartilaginous tumor formation which show an asymmetrical involvement of the body as the outstanding clinical feature

2 Chondrodysplasia is a condition which is usually asymmetrical but as several symmetrical cases are on record the term must

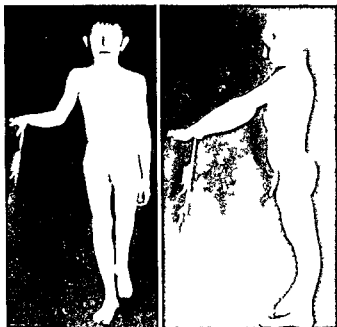


Fig. 8

Fig. 9

Figs 8, 9, 10 and 11. Photographs taken of the patient in 1927 at age of 9 years.

therefore be broader in its application than Ollier's disease.

The gradation of reported cases between those of frank multiple cartilaginous exostosis on the one hand and the so called chondrodysplasia with no change in anything except the internal architecture of the bones on the other is so varied and irregular that a definite classification of cartilaginous dystrophies is still impossible. The possibility that the widely different findings in some of these cases are only manifestations of different stages of the same condition must not be overlooked.

The cases of cartilaginous dystrophy which may be classified as Ollier's disease have been reported as follows:

Ollier	1
Nové-Josserand and Destot	1
(These 3 cases were made the subject of Molin's thesis)	
Witteck	
Burchard	2
Kochler	
Coon	
Sven Johansson	
Chris Johansson	
Bojesen	
Bentzon	
Jansen	
Col	
Case reported here	
Total	5

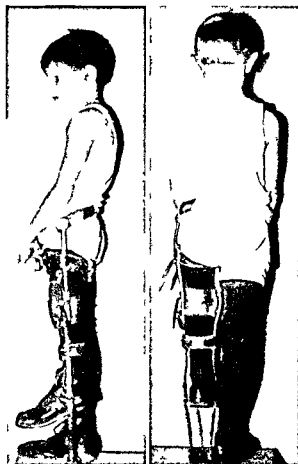


Fig. 10

Fig. 11

In 1924 Bentzon reported that he had found 12 cases in the literature besides his own but there is probably a mistake in the first 3 cases Bentzon ascribed 3 cases to Ollier and Molin and 1 to Nové-Josserand and Destot but Molin's thesis was built up on a pre-entation of 3 cases 2 of which were Ollier's and 1 that of Nové-Josserand and Destot.

A search of the literature since 1904 has shown only 3 additional cases. In 1925 Canelli (7) reported a case of cartilaginous dystrophy in an infant which lived but 2½ months with lesions involving the metaphyses of both humeri and of both femora the coxal bones and sacrum. The roentgenograms of this infant showed irregular deposits of calcium in the areas mentioned a picture quite similar to that shown in Fig. 4 taken when our patient was 8 years old. This case is interesting as a picture of marked symmetrical skeletal deformity due to irregular growth of cartilage in the metaphyses of the long bones. It seems reasonable to consider this condition



Fig

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Fig 3

as closely allied to Ollier's disease. In 1926 Maclaure (17) reported a case which he called Ollier's disease but which obviously falls outside this group as commonly accepted. It is not asymmetrical and the roentgenogram does not show typical lesions.

The history of our case follows:

F H aged 3 1/2 years appeared at the New York Orthopaedic Dispensary in July 1920 with a history of deformity of the left leg noted first at the age of 6 months. The child was essentially normal on examination except for a difference in the length of legs. The right leg was 14 inches long and the left leg 13 1/2 inches. The left tibia had marked lateral bowing with the foot in varus deformity. The right foot was in valgus. Roentgenograms were taken (see Fig. 1 and 2). There was no pain or swelling. No opinion was recorded regarding diagnosis and no treatment suggested at this time.

He came to the dispensary for 3 years during his time here seen at intervals of 6 months by the visiting nurse. His history without note outside from the fact that there was a gradual increasing disparity in length between the right and left legs. He was forced to

return to the dispensary when he could no longer walk.

In June 1924 at the age of 6 years the left leg was almost 6 inches shorter than the right shortening being distributed equally between thigh and leg with sharp lateral bowing of both tibia and fibula. An extension leg brace was ordered and a cast of plaster was ordered to correct the deformity of the left leg. A suggested X-ray roentgenogram was taken but unfortunately discarded. The report read: The symphysis is flattened and irregularly ossified areas are present but these are a few dense alcaresous nodules in the articular surfaces of the femur.

July 21 1924 The patient entered the hospital.

#### MEASUREMENTS OF LOWER EXTREMITIES

	L f	R f
T t l l	14	13 1/2
f t	7	7
T t	7	7

Left leg There is moderate rotational bowing of the upper third of femur which is considerably enlarged. Function at hip is normal. Knee shows normal muscle balance. There is marked posterolateral bowing of the lower third of the tibia. Both ends of the tibia are enlarged and the right end is deformed. The foot is rotated laterally 90 degrees. The Wassermann reaction is negative.

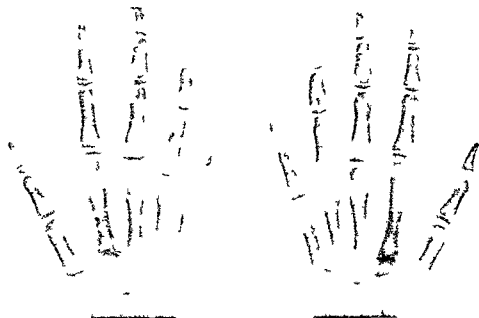


Fig 14

doubtful positive and tests made on both parents were negative but the patient was given four injections of neosalvarsan on the remote chance that anti luetic treatment might help. Following these treatments an uneventful year intervened. No history of any similar trouble could be elicited in any near or remote member of the patient's family.

June 1925 The patient again entered the hospital ward. The left leg was noted as being 6 inches short. Although there is some discrepancy between the measurements of 1924 and those of 1925 which might be due to the range of error of different examiners the disparity between the right and left leg remains the same.

## MEASUREMENTS

	Left I h	Right I h	Difference I h
Entire length anterior superior iliac spine to medial malleolus	14	0	6
Femur	7	10	3
Tibia	7	10	2
Circumference of thigh	1	2	
Circumference of calf	8	8	

An osteotomy of the tibia was done to correct the deformity. The bone was divided at a point below the center where it was found to be quite brittle. This healed uneventfully with correction of deformity. The patient wore a plaster of Paris circular splint for two months and then bore weight with his extension brace.

For the next 18 months the patient returned to the dispensary at intervals of every 3 weeks. The condition remained unchanged. Another roentgenogram was taken in March 1926 (See Figs 4 and 6).

January 1927 age 9 years the patient entered the hospital for an exploratory incision for the purpose of microscopic examination of the tissue. The

Wassermann was negative the Mantoux negative. The blood count showed red blood cells 4,750,000 white blood cells 14,800 haemoglobin 75 per cent polymorphonuclears 75 per cent small lymphocytes 20 per cent large lymphocytes 3 per cent transitionals 2 per cent. Urinalysis was negative.

At operation the periosteum was divided and the tibia was exposed at the lower metaphysis. It had a soft melon rind consistency and several pieces were removed for study.

Pathological report. Gross examination. The tissue consists of six small fragments of translucent bluish white homogeneous tissue resembling cartilage. Microscopic examination. Sections of cartilage show extensive cystic degeneration small and large cysts being present. There are also several rather large roughly circular spaces in the cartilage containing strands of delicate connective tissue.

Diagnosis. Cystic degeneration of cartilage (see Fig 7).

There is nothing of moment to report until his most recent examination in September 1927. See Figs 8, 9, 10 and 11. Examination shows that all motion in the left leg are free and normal. General condition is excellent.

## MEASUREMENTS SEPTEMBER 1927

	Left I h	Right I h	Difference I h
Anterior superior iliac spine to ole	19	5	6
Anterior superior iliac spine to medial malleolus	16	23	7
Femur	9	3	4
Tibia	7	0	3

Total height 46 inches

Roentgenograms were again taken at this time which show progressive change in the lesion (see Figs 12, 13, 14, 15 and 16). It is interesting to note



- 4 BUTCHARD Zur Diagnose der Chondromatosen Fibro- und zystischen Degeneration der Knochen Fortschr a d Geb d Röntgenstrahlen 1911 13 xiv 113
- 5 Idem Ueber multiple Enchondrome in den langen Röhrenknochen von Kindern Fortschr a d Geb d Röntgenstrahlen 1912-13 xiv 91
- 6 CAMPBELL HORACE E Hereditary diffuse chondrodysplasia report of three cases J Bone & Joint Surg 1925 vii 982
- 7 CANELLI ADOLFO F Di un caso particolare di chondroplasia Clin P d d Regia Univ italiana Torino 1916 p 513
- 8 COLL WALLACE H Chondrodysplasia Surg Gynec & Obst 1926 xli 359
- 9 COON CLARENCE I Dyschondroplasia Am J Orth Surg 1911 ix 604
- 10 EHRENFRIED A Hereditary deforming chondrodysplasia multiple cartilaginous exostoses J Am M Ass 1917 lxxiii 50
- 11 JANSEN J W F Un cas de chondromatose unilatérale (Malade d'Ollier) Acta Radiol 1915 iv 3
- 12 JOHANNESSEN CHR Kasuistische Mitteilung, z Beleuchtung der Ollierschen Wachstumsstörung Monatsschr f Kinderh 1923 xxv 294
- 13 JOHANSSON SVEN Ein Beitrag z Kenntnis der Ollierschen Wachstumsstörung Nord m d Arkiv 1916 Nr 18
- 14 IRTICH SIR ARTHUR The nature of the structural alterations in the disorder known as multiple exostoses J Anat 1906 liv 101
- 15 KOEHLER A Fortschr a d Geb Röntgenstrahlen Ergänzungsband 1 132 Die normale und pathologische Anatomie des Hüftgelenks und Oberschenkels in roentgenographischer Darstellung Hamburg 1903
- 16 LEWIN PHILIP Multiple cartilaginous exostoses diaphyseal aches Surg Gynec & Obst 192 xlv 48
- 17 MACCLAITHE Un cas de nanisme par dyschondroplasia d'Ollier Rev d orthop 1926 xiii 653
- 18 MOLIN La dyschondroplasia Thèse Lyon 1900
- 19 OLLIER LOUIS V L L Bull de la Soc de Chir de Lyon 1899-1900 iii 22
- 20 ORD A G A case of hereditary deforming chondrodysplasia Lancet 1925 ii 18
- 21 PERRY N M Multiple chondro-osteoma Surg Gynec & Obst 1915 xx 619
- 22 VOORHOEVE N L'image radiologique non encore décrite d'une anomalie du squelette Acta Radiol 1924 iii 407
- 23 WHITE RENFREW Two rare bone diseases Brit J S 1924 July 76
- 24 WITTEK ARNOLD Die Olliersche Wachstumsstörung Bibliotheca medica E 7 Stuttgart E Naegle 1906



MULTIPLE POLYPOSIS OF THE COLON<sup>1</sup>

By HAROLD E. HULLSIFK, M.D., F.A.C.S., St. Paul, Minnesota  
 I. tru t S. g. ry M. d. I. S. hool U. y f M. est

THE term polyposis of the colon has been interpreted by different writers at various times to mean a single polyp scattered polyps or an actual polyposis in which we find the entire large bowel including the rectum the seat of thousands of sessile adenomatous tumors. The finding of a single polyp is certainly not a rare occurrence neither are multiple or scattered sessile polyps in the same bowel uncommon. Areas of polyposis which are the result of ulcers, stricture, carcinoma or other mucous membrane irritation are frequently encountered but we still have remaining that type of polyposis which occurs most often in young people and in which the normal mucosa is entirely replaced by countless small tumors of approximately the same size. This latter form has been very correctly named by Erdmann and Morris, adolescent congenital disseminated polyposis in contradistinction to all other forms.

Lockhart Mummery classifies the adenomata occurring in the bowel as follows: (1) true multiple adenomata, (2) polyps associated with hyperplastic tubercles, (3) multiple polyps associated with old stricture of the colon, (4) polypoid condition resulting from ulcerative colitis. An inspection of the groups shows that they fall very nicely into Erdmann's classification, the first being the adolescent type found in the youth with the congenital predisposition, the three remaining groups the result of one kind or another of irritation or trauma to the mucosa.

The classification of Erdmann and Morris made on a clinical basis comprises two forms: (1) adult acquired type and (2) adolescent congenital disseminated type. They place in the first group the single polyp. In view of the fact that single polyps are sometimes found in very young children it might be suggested that the terms adult and adolescent be omitted, they being called simply congenital and acquired. Further the term adolescent might be confusing in that while the condition in the second group is undoubtedly the result of a

hereditary predisposition at the same time it occasionally does not manifest itself until after adolescence.

The congenital form usually becomes evident in childhood or youth rarely has a discoverable as occasioned and etiological lesion is often shown in other members of the family and has a high malignancy incidence.

## HISTORICAL

Menzel in 1711 reported a case of what he called the earmarks of the congenital type in a boy of 15 years. In 1831 Wainer and in 1839 Lokitsky reported cases of multiple polyposis the type of which is uncertain. Lebert's case reported in 1861, a female aged 32 years, is the first description of the polypoid themselves. The case reported by Luchka in the same year was in a woman aged 30 years. In this case the mucosa of the entire colon and rectum had been replaced by polyps. In Woodward's case a woman aged 44 years the entire colon including the rectum showed polyps. Virchow at this time reviewed a case of his and of Lebert and of Luschka under the term colitis polyposis cystica. Von Port collected 14 cases which were added in a tabulated list to 35 more collected from the literature by Doering in 1907. In this series are given two personal cases of Doering's. Soper in 1916 added 8 more cases. Struther in 1918 reviewed 9 cases of multiple polyposis of the intestinal tract and in 1920 cases of multiple polyposis of the gastro-intestinal tract. In this series a number contained polyps in the small bowel and stomach. These possibly do not belong in a series of cases of polyposis of the colon but have been included. Likewise a number of cases in the same series have been excluded because of insufficient data to make it permissible to list them as true cases of multiple adenomata.

A review has been made of the above mentioned cases and others which including the writer's total 117. Following the scheme set by Doering the 117 collected cases have been

classified under the headings of age site duration of symptoms malignancy hereditary tendency treatment and results and in attempt has been made to draw some conclusions from the information collected Since all cases listed as multiple polyposis of the colon are included it is probable that a number at least do not belong to the congenital type although a number which were given in sufficient detail to mark them as obviously belonging to the acquired type were excluded

## AGE

Quinn and Landell report that over 50 per cent occur between the ages of 15 and 35 years Cripps saw three cases in the same family one aged 20 another 17 and the third 16 years of age Erdmann had two male patients 14 and 16 years of age and one female aged 15 years The writer's case was that of a male aged 32 whose brother succumbed to a multiple polyposis (proved at autopsy) at 34 and the father at 44 after having been ill with bowel trouble for years Of the 17 cases the ages are given in 93 The average age is 30.9 years divided as follows

	C
Under 10 years	5
10 to 20 years	23
20 to 30 years	1
30 to 40 years	23
40 to 50 years	1
50 to 60 years	4
60 to 70 years	
70 to 80 years	

The youngest patient was 5 years the oldest 74 The number of patients between 15 and 35 years for which period Quinn and Landell quote as 50 per cent was 65 or 65.6 per cent in this series This is especially significant when one considers the following paragraph

## DURATION OF SYMPTOMS

The duration of the symptoms was noted in 60 of the 17 cases as follows

	C	P
Since infancy	5	8.3
Years	9	15
0 to 10 years	0	1.2
10 to 20 years	8	13.3
20 to 30 years	4	6.7
30 to 40 years	7	11.7
40 to 50 years	6	10.0
50 to 60 years	1	1.7
Less than 1 year	5	8.3

Of the 60 cases in which we know the duration of symptoms 31 or approximately one half have probably had symptoms 10 years thus the average age of 30.9 years would have been reduced materially if these patients had been discovered and their condition had been diagnosed earlier

## SEX

It has been generally supposed that males are more frequently affected However in this series there was only a slight difference Of 98 in which the sex was given 57.53 per cent were males and 46.47 per cent were females

## SITE

The area involved was given in 106 cases as follows

	C	P
Rectum and colon	44	41.6
Rectum alone	26	24.5
Colon	2	2.0
Large and small bowel	11	10.4
Large small bowel and stomach	1	0.9
Rectosigmoid junction	1	0.9
Cecum and colon	1	0.9
Total	106	

## MALIGNANCY

In many of the cases the question of malignant change has not been settled in fact very often it could not from the nature of the cases be accurately determined However in 42 cases or 34.6 per cent of the total carcinomatous change was either present at the time the diagnosis was made or occurred later This is a decrease of 8.4 per cent from Doering and Soper's series in which the malignancy was 43 per cent

When we consider that 42 of the 17 cases were known to have malignant disease and that 31 more in whom the question of malignancy remained in doubt died rather early of cachexia anemia or bleeding it is only fair to suppose that the malignancy index in this series is actually higher than the figures represent Mummery states that almost all recorded cases of multiple polypi of the colon eventually become malignant and this was the factor to be reckoned with in treating these cases

MULTIPLE POLYPOSIS OF THE COLON<sup>1</sup>

By HAROLD I. HUISIKK, M.D., F.A.C.S., ST. PAUL, MINNESOTA  
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THE term polyposis of the colon has been interpreted by different writers at various times to mean a single polyp, scattered polyps or an actual polyposis in which we find the entire large bowel including the rectum the seat of thousands of adenomatous tumors. The finding of a single polyp is certainly not a rare occurrence neither are multiple or scattered multiple polyps in the same bowel uncommon. Areas of polyposis which are the result of ulcer, stricture, carcinoma or other mucous membrane irritation are frequently encountered but we still have remaining that type of polyposis which occurs most often in young people in whom the normal mucosa is entirely replaced by countless small tumors of approximately the same size. This latter form has been very correctly named by Erdmann and Morris adolescent congenital disseminated polyposis in contradistinction to all other forms.

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The classification of Erdmann and Morris made on a clinical basis comprises two forms: (1) adult acquired type and (2) adolescent congenital disseminated type. They place in the first group the single polyp. In view of the fact that single polyps are sometime found in very young children it might be suggested that the terms adult and adolescent be omitted they being called simply congenital and acquired. Further the term adolescent might be confusing in that while the condition in the second group is undoubtedly the result of a

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## HISTORICAL

Menzel in 1771 reported a case of what has all the earmarks of the congenital type in a boy of 15 years. In 1831 Waener and in 1839 Iohann Ky reported cases of multiple polyposis the type of which is uncertain. Lebert's case reported in 1861 a female aged 32 years is the first description of the polyps themselves. The case reported by Luschka in the same year was in a woman aged 30 years. In this case the mucosa of the entire colon and rectum had been replaced by polyps. In Woodward's case a woman aged 44 years the entire colon including the rectum showed polyps. Virchow at this time reviewed a case of his and of Lebert and of Luschka under the term colitis polyposis cystica. Von Hartmann collected 14 cases which were added in a tabulated list to 35 more collected from the literature by Doering in 1907. In this series are given two personal cases of Doering's. Soper in 1916 added 5 more cases. Struther in 1910 reviewed 39 cases of multiple polyposis of the intestinal tract and in 1914 10 cases of multiple polyposis of the gastrointestinal tract. In this series a number contained polyps in the small bowel and stomach. These possibly do not belong in a series of cases of polyposis of the colon but have been included. Likewise a number of cases in the same series have been excluded because of insufficient data to make it permissible to list them as true cases of multiple adenomata.

A review has been made of the above mentioned cases and others which including the writer's totals 177. Following the scheme set by Doering, the 127 collected cases have been

classified under the headings of acute or chronic duration of symptoms malignancy hereditary tendency treatment and result and in it tempt has been made to draw some conclusions from the information collected. Since all cases listed as multiple polyposis of the colon are included it is probable that a number at least do not belong to the congenital type although a number which were given in sufficient detail to mark them as obviously belonging to the acquired type were excluded.

## AGE

Quenu and Landell report that over 50 per cent occur between the ages of 15 and 50 years. Cripps saw three cases in the same family, one aged 10 another 17 and the third 10 years of age. Erdmann had two male patients 14 and 16 years of age and one female aged 4 years. The writer's case was that of a male aged 45 whose brother succumbed to a multiple polyposis (proved at autopsy) at 34 and the father at 44 after having been ill with bowel trouble for years. Of the 17 cases the ages are given in 93. The average age is 30.9 years divided as follows:

	C
Under 10 years	5
1 to 20 years	23
2 to 30 years	1
30 to 40 years	23
40 to 50 years	1
50 to 60 years	4
60 to 70 years	5
70 to 80 years	1

The youngest patient was 3 years the oldest 74. The number of patients between 15 and 35 years for which period Quenu and Landell quote as 50 per cent was 63 or 65.6 per cent in this series. This is especially significant when one considers the following paragraph.

## DURATION OF SYMPTOMS

The duration of the symptoms was noted in 60 of the 127 cases as follows:

	C	P
Since infancy	5	8.3
Less than 1 year	7	15.2
Over 10 years	9	15.2
5 to 10 years	8	13.3
4 to 5 years	4	6.7
3 to 4 years	7	11.8
2 to 3 years	6	10.1
1 to 2 years	7	11.8
Less than 1 year	5	8.3

Of the 60 cases in which we know the duration of symptoms 31 or approximately one half have probably had symptoms 10 years thus the average age of 30.9 years would have been reduced materially if these patients had been discovered and their condition had been diagnosed earlier.

## SEX

It has been generally supposed that males are more frequently affected. However in this series there was only a slight difference. Of 98 in which the sex was given 52, 53 per cent were males and 46, 47 per cent were females.

## SITE

The area involved was given in 106 cases as follows:

	Cases	Per cent
Rectum and colon	44	41.8
Rectum alone	26	24.7
Colon	22	20.9
Large and small bowel	11	10.4
Large small bowel and stomach	1	0.9
Recto sigmoid junction	1	0.9
Cecum and colon	1	0.9
Total	106	

## MALIGNANCY

In many of the cases the question of malignant change has not been settled in fact very often it could not from the nature of the case be accurately determined. However in 44 cases or 34.6 per cent of the total carcinoma change was either present at the time the diagnosis was made or occurred later. This is a decrease of 8.4 per cent from Doering and Soper's series in which the malignancy was 43 per cent.

When we consider that 4 of the 127 cases were known to have malignant disease and that 31 more in whom the question of malignancy remained in doubt died rather early of cachexia inanition or bleeding it is only fair to suppose that the malignancy index in the series is actually higher than the figures represent. Mummery states that almost all recorded cases of multiple polyposis of the colon eventually become malignant and this was the factor to be reckoned with in treating these cases.

TABLE I

A th	Ag	D	S	M l cy	T m t	R lt	F mly h t y	C f d th
Skif k	M s		R					
C pp	M	yr	R C		f pol ps	Im l	t	
Wh h d	M		R C		S f p l p	Im l		
m h	M	vr	R C	C ma		D d	B h d	
G ll s	M		R C Cae m			D d		I
H dl d	I		R C	C m		D d		C
I k h	M		R		R m l f pol p	Im d	M h	
I l s	F s		R C Cae m			D d		Bl dng
P	F					D d		Bl d
M k	F		R	C m		I l		C re
P	F		R	C ma		I d	B h d	C
T	M			m		D l		C
G l	M	l h l l h o l	R Cae m			D d		I
H ll h	M 9	l l l l h o d	R S a h m	C m		I l		Cae
L lk t	I		R	m		D l		I
Lebe	F		C R			I d		I
W ll	M	Y	C R	m		I l		C re
B d h	M		C R Cae m	C ma		D d		C re
H	I		C R	C m		D l		C
H	F		T C m d	ma		I d		C re ma
P w	F	Y	ll rec l l m m		R ec f l	l l W ll l l		I
L d	I	Y	R	C m	Am f m			C re
L b rsh s	I 6		R C l m l	C m		I l		C re
R tt	M	Y	R C			D l		Bl d
R s	F	Y	R	C m		I l		C re
M	M	Y	R I C	C m		I l		C
H d			R					
V l s	F	6	R					
R d s	I 3	Y	R Cae m TC		R ec f l	I l		P
K								
H l		Y	ll c l g	C m	R ec f l	W ll		
Ca h l s	I		F t t t					Bl f
S hm l s			R	C m		I d		C
N m k	F	4 Y	R C t m l m			D d	F h co	I

C t 4 s 1 V P D G A h Z h f Cl l  
N mb t 5 1 Doe g A h f M Ch l

TABLE I-C (continued)

[illegible]

TABLE I—Continued

A l	A	l	M l	T t m	R h	F m l h t r y	C f d h
N f l	l		R l	R m l f l y l	l m l		
N f l	l		R	A l f			
I l l	M		m l	k l f h l			
E l l	M		R	R m l f m			
N l	M		R l l l	M l l y	m l m d h		
	M			R m l l f m	W l l		
W	l		l	A l l l	W l l m		
I k	l		R l l l				
II H l	F	Lo	C R		I l		I
II H l	M		m l R		I l		Cat om
W l l	l		R		D l		I
	l	l	R	I l l l m m	W l l		
C l l	M			R m l f l h l			
I l l l	l		m l	l m l m l	R l		g d y pos op h
N l l l	F		R	A l m	I l		C
k	M		k	l	l l h		
T	M		k	l m y	R ry		
T l l	l		R l	I l m h l	W l l		
L l h l	l			l m h l	I l		hock
A B k	l		R l	M l l l	I l	l l	I
I J N	l		I	R m l m l	W l l m		
	l			l	W l l		
h	l		l	C l m l l l	W l l		
l	l		l	R l l l	l m l		
h	F		l	l l	l m l		
l	l		R	l	l l		P m
l	l		R	l	I l		I h
h	M		R	E l y l m	I l		C h d
S l l	F		R m l	N t t m			
S h 5	M		R	N m			

TABLE I—Continued

A th	A ge	D t	M l	T tm t	R lt	F rly hist ry	C f l th
ruth 96	F 5		gm d	N tr tm t			
rut 9	F		C	N tr m t	D d		
tru b 93	M 7		R C	K u m	F dln m t		
ruth 99	M		R lrm d	Medic l	Fail r t		
W rw 90	F 5	mo	C m ll	C m	D ed		P t t s
Warwick	M	mo	Rec m l	C m	D d		M t m a t
M rre	M		P	l m sal t h m l m l pol d s			
Lock ar 3	F	0 yr	ll m	ll oc m y	W ll		
M m m r s							
C M x l	M	r	C K		D d		J C m
All	F 6		C m m C	l h h l l m t l m	Imp l		
A th ca	M	A	ll m	ll m m tal h ec o	D d	E h l f h	D d 4th d y
ruth 95			C	ll m m d ec l m o	D d		
truth 90			R	T	I d		
9				ll m m	I d		
tr th			R m l	C l m m with 5 ch	D d		
tru 95			C	ll m m l m m	Imp d		
tru			R m l	ll m m	Imp l		
trut			lrm d	ll m m l m m	Imp l		
t			C	ll m m	E ll t		
tru b 5			C	l l m m ch m m	D d		C m
tru b			R C m d	C m	D d		C m
ru			L m b o l	M m l	D d		
			R C	m a	O r m t g n	I m r o d	
ru 9			R C	M cal	Imp d		
ru 95			C	M cal	Imp o v d		
ru			R C	M cal	I m m ed		
tru			C	M d l	I m p d		
tr b 3			P m l	M cal	I m p		
ruth			C	M cal	D d		
tru 5 95			R	M cal	I m p d		
tr t 6			C	M cal	I m r o d		
ru 95				M cal	I m d		



## FAMILIAL TENDENCY

A feature of congenital polyposis which would undoubtedly be more evident if information were available is the inherited predisposition of members of a family to exhibit this disease. Mummery says: "It appears to be a hereditary condition as it can be traced through several generations and the curious thing is that in such families a large proportion of individuals die at a comparatively early age from cancer of the bowel." Dukes shows charts of three families. In the first family one daughter had multiple adenomata while her mother, six uncles and aunts and her grandfather died of cancer of the large bowel. In the second family two members are suffering from cancer of the rectum or multiple adenomata, four aunts and uncles are involved and both paternal grandparents. In the third family five members of the family involving three generations on both sides either have died of cancer of the colon or have multiple polyposis. In the writer's case the patient, his brother and father died of cancer superimposed as we know in the case of one of the two sons and probably in that of the father on a multiple polyposis. In the series of cases analyzed a definite hereditary tendency was noted in 13 cases or 11.1 per cent.

## MORTALITY

In the entire series there were 61 known deaths, 4.1 per cent.

## TREATMENT

Fifty-one cases, 40 per cent, are known to have been treated surgically. On the cases in which the treatment was either medical or not stated, insufficient data were given to draw any conclusions as to methods. In the 51 cases operated upon there were 18 deaths, a mortality of 35.3 per cent. In the remaining cases there were 44 deaths, a mortality of 56.5 per cent.

## TYPES OF OPERATION

These are given more to show the number of procedures used than to make any deduction from the results. The type of operation performed was given in 51 cases as indicated in the following table:

C	lectomy	C
1	Removal of rectum	8
11	lectomy in	5
Col	lectomy through removal of part of colon	5
1	Appendicectomy	4
R	lectomy of rectum	3
1	lectomy of rectum with ileostomy	3
11	proctectomy	2
11	ileostomy	1
1	Prostectomy	2
1	ileostomy	1
C	mpl. col. c. my. ileostomy of ileum	1
1	ileostomy	1
1	lectomy of part of sigmoid	3
1	ileostomy	1
T	lectomy of ileum	1
11	ileostomy with removal of part of ileum	1
1	ileostomy	1
1	ileostomy	1

In a consideration of the surgical procedure to be undertaken it immediately becomes evident that the type of operation depends on certain features in each individual case, viz. malignancy, extent of involvement, condition of the patient and the technical ability and surgical experience of the operator.

The usual extensive involvement in the congenital type of case renders a complete removal of the entire polyp-bearing area a more or less heroic task. Erdmann says that the problem first is one of the determining of the extent of the process before operation. This can sometimes be done by palpation of the thickened gut wall as was possible in Carroll's patient. In our own case the entire bowel from ileocecal valve to the anus was so markedly thickened and doughy that a diagnosis of the extent was immediately possible when the abdomen was opened. In such a case it would seem useless to remove a part even though that part had already undergone malignant change and to allow to remain other highly potentially malignant tissue or tissue which may already have become malignant in several separate and apparently primary cancerous areas have been found in the same case. Lillienthal, Soper and Erdmann have successfully done total colectomies with ileostomy, ileostomies. Coffey was the first and I believe so far the only one to remove successfully the entire colon, sigmoid, rectum and anus with a permanent ileostomy in the treatment of this condition. The author's patient was operated upon after Coffey's technique for colectomy but died on the fourth day. Less radical





Fig 3. T. f. m. l. t. l. i. m. i. n. m. m. r. f. o. l. l. g. n. l. l. g. l. g. u. l.

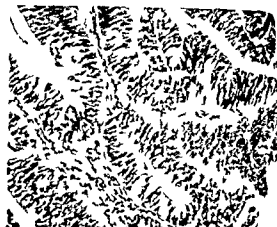


Fig 4. H. g. l. m. g. t. t. f. m. l. g. n. t. p. o. l. y. p. C. t. g. l. l. l. l. t. l. t. l. t. l. t. l. m. a. p. h. l. m.

in pp ar c th i at inv of tl pr v u ximination and j im n v tik f r m r o c o p i c amination i th at tati h g n i of arcinom y. Microscopic section (Fig 3 and 4) sho el no nne ti tu pr sc t ut th ntr m s con t d of r v lrg gland of r r gular hape lin l b v atyp l large pith lial ell v hich sh d many m tot i g u r and large hyperchr iati nu lei and gr in la l s mann r l r m th iz ind r r gular of th gl n l and th m j rati cun liff ren t ti n of tl pithelium a d g n o i of ad no noma i mad.

The problem f r u as th r y ungman t o of ho e fam l had l d of a mult i l poly p i had n kno m l g n nt and anoth r p o sibly malignant ca in h bo l. An exploratory operation to d r m e if po sibly th ext nt of the poly p i and th pr sc n or ab cence of other malignant areas as adv l our i k a b i g to mak an ileostomy if it r sid ed f sible.

On S p t m b r 3 the abd n en w r open d. The th ken t an loughy f l g of the colon promptly p o d th pr s n of th p l y s as far as the ileo a l v a l e. A il stomy was lo e and the patient a r turn d t b l. H soon b gan to show signs of of t u t o n n l th l o s t o m y h d to l e opened premature ly but v r e fort i ate enough to escape with l t t l or n n f c t i o n. Aft r a stormy f v days v h i h the l r n g as i ad quite he lid v r y ll and by S p t m b r 30 the d s ch a r g the t n v f a n r m al stool and he v s d med to be in good on l t n f r h i s o n l p e r a t i o n.

On th l t a total e l e c t o m y aft r th m th o d s r i l d b y C o f f v s s done the anus a d r e c t u m b i n g l e f t a n l q u a r n t n e p c k i n s r i e d. Although his pul r p i d he sto d th operation v l l. H took fl u d fr c l b y m u t h a n i s e m e d to b d i n g v e r y l l u n t l t h e n i n g of the third day when he l g n t o r g u r g i t a t e small mounts. H i s continued p t of gastric lavag and other procedures and l cond t o n g v o r g r a d l l y u n t i l the mo g of O t b r 4 h n he died.

The colon removed at operation (Fig 5) showed a poly p i which extend l from the r e c t u m up to the il o c a l junction. At no point as any mucosa v i b l but p l c e d c l o s e t g t h e r on the inner surface er countless proj ctions. For the mo t part these v e r e small and triangular in shape with the base at tached to the all and the t l e x t e d g i n t o the lumen of th bo l. They measured about 3 to 5 centimeters in length and v e r e covered by high col umnar epith lum hich was normal in appearance. At various p i n t s throughout the colon v e r e other large p l y p u s u a l l y attach d b y a pedic l long enough to allo th m to e t e n d v l l o u t b e y o d the small r o n e. Th s e m e a d r to 3 centimeters in diamet r and p r e n t e l r r gular surfaces. Microscopic sections sho ed them t b e i d e t i c a l i t h th o v h i c h h d b e n r m o v e d i n 9 5 and 19 6. The poly p of the colon v e r e of all sizes and shapes v a r y i n g from t v t r i a n g u l a r o n e s to large p d u n c u l a t e d o e s but none of th m showed a y s g s of malignancy.

The autop y as performed O t o b e r 4. There as an absenc of the colon and the r e c t u m remained a a necrotic stump co e r e l b y a fibrinou exudate. Cross section sho ed th wall to be necrot c. On the mucosal surface v as a raised ann l a r u l e r a t e d area i t h th c k f i m o v e r l a n g n g necrotic ed s g v g th picture typical of a v a l g n a n t p r o c e s but with no sugg t i o n of its h a v i n g a r e f r o m a poly p. Microscopic sect on (Fig 6) sho ed it to c o n s t o f large m a s e of e p t h l a l c l l v h c h e r e atypical in app a r a n c and v h i c h v r m a k n a poor attempt at gland formation. Th e p t h l g th ad i n f i l t r a t e d t h e n t l l a n l e t n d b a c k u d r the normal epithelium.

There was also a s all but act i tub r e u l o u s l e s i o n i n a c h l u n g the ap on the right and th upper part of th lo r lob on the l f t. The e c o n s t e d of a p u c k e r d s c r s u r r o u d e d b y small tuberc l i n some of v h c h t h e r e was a small amo nt of caseous necrosi. Th e v l o a s m l l a b s c e s n t h a n t e r i o r a b d o m i n a l w a l l a t t h u p p e r l e g e f t h i n c i o n



FIG. 5 Entire colon removed at operation. The smaller mass is rectum removed at necropsy.

but it was well circumscribed. No sign of inflammation was found except in the stump of the rectum and this was entirely localized. No anatomical reason for death was found.

#### CONCLUSIONS

1. There are two distinct types of polyposis: acquired and congenital.
2. Multiple polyposis is most common in childhood and youth; the average age in this entire series being 30.9 years, with over 65 per cent occurring before 35.
3. The symptoms usually persist for a long time before medical attention is sought.
4. Males and females are affected about equally.
5. The probability of malignant change is high in this series: 34.6 per cent.
6. There is a definite hereditary tendency.
7. The mortality is high: 47 per cent under all forms of treatment.
8. The treatment is not yet standardized.

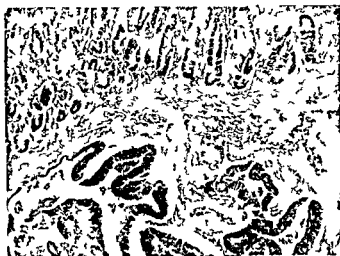


FIG. 6 Section of rectum removed at necropsy showing irregular masses of atypical epithelium.

#### REFERENCES

1. ALLEY R. G. A case of multiple polyposis of the intestine. *Clifton Med Bull* 1926 vii No 4.
2. BOCK. *Proc Roy Soc Med* vii 192.
3. BRATRUD THEO. *Surg Gynec & Obst* 1914 xiv 31.
4. BABBLER NIEBRUGGE and FISCH. *J Am M Ass* 1909 lxi 1235.
5. CREYX D. and MASSIAS C. *Recit et Colite Proliferantes Polyadenomatoses du colon sclerose de la tête du pancreas*. *J méd de Bordeaux* 1921 li 573.
6. CARROLL WILLIAM. *Surg Gynec & Obst* 1915 xx 41.
7. COFFEY R. C. Colonic polyposis with engrafted malignancy. *Surg Gynec & Obst* 19 6.
8. DOERING HANS. *Die polyposis Intestini und ihre Beziehung zur carcinomatosen Degeneration*. *Arch f klin Chir* 1907 lxxviii.
9. DUNN J. N. Personal communication.
10. DRUECK C. J. Benign tumors of the lower bowel. *Am Med* April 1920 p 204.
11. DUKES CUTHBERT. Simple tumors of the large intestine and their relation to carcinoma. *Proc Roy Soc Med* 1925-26 ix Sect Surgery Subsection Proctology p 9.
12. ERDMANN J. P. and MORRIS J. H. Polyposis of the colon. *Surg Gynec & Obst* April 19 5 xl 460.
13. ERDMANN ROBERT. Polyposis coloni. *Ann Surg* 1917 lxxvi 231.
14. FISHER. Quoted by Soper.
15. FURNIVALL P. Three cases of multiple polyposis of the rectum and large intestine. *Proc Roy Soc Med* 1913-14 vii Sect Surgery Pt III p 45.
16. HEWITT and HOWARD. *Arch Int Med* 19 5 v 14.
17. JUSTI KARL. Colitis hyperplastica polyposa dysenterica. 1921 cxxxviii 30-42.
18. LOCKHART MUMFERY. *Proc Roy Soc Med* 1918-19 Sect xii Surg p 43.
19. LILIENTHAL. Quoted by Soper.
20. MENZEL. Quoted by Hewitt and Howard.
21. MORRISON RUTHERFORD. *Proc Roy Soc Med* 1913 vii 198.
22. MURPHY JOHN B. *Surg Clin Chicago* 1916 v 447.
23. MCKENNEY D. C. Multiple polyposis of the colon: conservative treatment. *Tr Am Proct Soc* 1925.
24. NEWBOLT C. *Proc Roy Soc Med* 1913 vii p 272.
25. NORBURY. *Proc Roy Soc Med* 1913 vii p 193.



Most of the reported cases of hæmatometra are of congenital origin. Among the earliest cases in this group is that of Chegoin in 1899. The patient was a married woman aged 32 in whom hæmatometra had developed as the result of a congenitally imperforate uterus and absence of the cervix. In the same year Prince reported a case of hæmatometra which had followed difficult and premature delivery. He stated that while it is not unusual for retention to result from congenital malformations, he was unable to find another instance reported in which it had developed following labor. Both of these cases were successfully treated by puncture.

Bernutz in 1848 reviewed from the literature a number of cases of hæmatometra and proposed a classification on an etiological basis into four groups: (1) congenital; (2) following labor; (3) a reflex type comparable to cystitis with retention; and (4) retention resulting from emotional states such as shock and anger. He was the first to recognize that complete obstruction is not essential for the production of hæmatometra.

Dubruel's case reported in 1889 was of interest because hæmatometra developed after the menopause had been passed. The origin of the bleeding was not proved but fibromyoma was suspected.

A number of cases have been reported in the literature since 1900 and more attention has been given to the problems of treatment. Horrocks in discussing treatment condemned the indiscriminate use of the puncture method which he believed to be applicable only in cases in which hæmatocolpos alone was present.

Quinn and Le Sourd in 1906 reviewed from the literature 8 cases of uterus didelphys complicated by hæmatometra. Six of these had been treated by conservative operations consisting either of drainage through the vagina usually combined with abdominal exploration or of hemihysterectomy. These authors emphasized the importance of abdominal exploration at the time of vaginal drainage to guard against the danger of rupture of adherent hæmatosalpinx should the sudden loss of fluid from the uterus cause it to contract rapidly and extensively. They also

pointed out that in a uterus didelphys menstruation may occur normally on one side coincident with the development of hæmatometra on the opposite side. In one instance pregnancy had occurred in the unobstructed portion of such a uterus. While they were not able to find any record of pregnancy following conservative operation on uterus didelphys they believed it to be theoretically possible.

In 1907 Sikora in discussing the treatment of hæmatometra called attention to the fact that the methods of treatment had varied from time to time but that there had been a progressive tendency toward the use of more radical surgical measures. He concluded that conservative measures should be employed whenever possible whether the uterus is single or double but that when the uterus is diseased it should be removed.

Andrews in 1911 reported two cases of hæmatometra complicated by hæmoperitoneum. He had noted two similar cases in the literature.

Gellhorn in reporting an instance of hæmatocolpos hæmatometra and hæmatosalpinx secondary to gynaecosis in a case in which the menopause had long since been passed called attention to the small number of similar cases reported in the literature. He concluded that the most common cause of gynaecosis in the aged is a senile adhesive process secondary to senile vaginitis. As a result of this process which is really a thinning of the squamous epithelium of the vagina a raw surface is created, the lumen of the vagina is narrowed as a result of changes in its elastic fibers and when the walls approximate bands and constrictions develop. This type of obstruction he believed is most likely to occur at the juncture of the middle and upper third of the vagina because of the narrowing produced at that point by the levator ani muscles. The source of the bleeding in the few cases is usually from a tumor.

Cases of various types and etiology have been reported by Gutierrez, Lising, Furslow, Jones and others (17, 11, 18, 20, 4, 28).

#### CASES FROM THE MAYO CLINIC

Twenty-three cases of hæmatometra, all but one of which were verified at operation

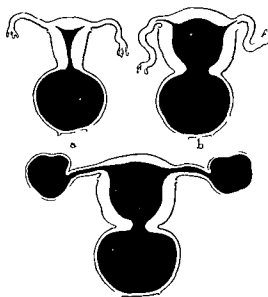


Fig. 3. S m of th po tl ml t mm of mpl  
b tru t m l t t t m w th t mm of th r v f  
d pl to a pe t t t m w th t f t c t l  
d (t ) o t b n t l t t l  
d m nta y h l l t d d lphy t l t t f  
th n on f

were observed at the Mayo Clinic from 1911 to 1916 inclusive. In 11 of the cases the obstruction was congenital and in 1 it was acquired (Table I and II).

#### CONGENITAL TYPE OF OBSTRUCTION

*Etiology.* Embryologically, according to Piersol, the uterus develops from the muellerian duct which unite at about the eighth week of intra uterine life. After the union of these ducts the intervening septum disappears and a single tube is formed the anlage of the uterus. This end blindly and is joined to the urogenital sinus by a solid cylinder of cell. This lumenless segment of the fused muellerian ducts represents the anlage of the vagina. By the end of the fourth month of intra uterine life it too has normally acquired a lumen and the enlargement of the cervix has made its appearance at the uterovaginal juncture.

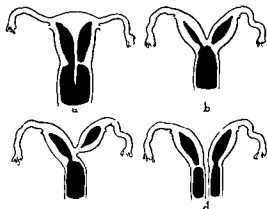


Fig. 3. S m of th po tl ml t mm of mpl  
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d (t ) o t b n t l t t l  
d m nta y h l l t d d lphy t l t t f  
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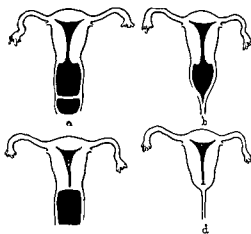


Fig. 3. S m of th po tl ml t mm of mpl  
b tru t m l t t t m w th t mm of th r v f  
d pl to a pe t t t m w th t f t c t l  
d (t ) o t b n t l t t l  
d m nta y h l l t d d lphy t l t t f  
th n on f

The chief anomalous conditions of the uterus and vagina depend on defective or incomplete development or imperfect fusion of the two muellerian ducts. Arrested development of the lower part of the fetal canals accounts for the absence of all or any part of the cervix or vagina or the persistence of a membrane obstructing their lumen at any point. Depending on the extent to which failure of fusion occurs all degree of duplication may result. Duplication and obliteration of different portions of the genital tract may coexist in numerous combinations.

In order that hematometra or hematometerpos may develop as a result of congenital anomalies two conditions must be fulfilled: the uterus must be sufficiently well developed to perform the function of menstruation and the anomaly must include some type of obstruction which prevents the escape of the



Fig 4 Case 7 Cross section of uterus with hæmatometra from congenital atresia of the vagina and stenosis of the external os

menstrual products. Figures 2 and 3 illustrate some of the more common anomalies or combinations of anomalies in which these conditions are fulfilled.

The most common type of obstruction is an imperforate hymen or the persistence of a membrane across the vagina a short distance above the hymen (Fig. 1a). Almost as often varying portions of the vagina may remain obliterated the atresia usually beginning at or just beyond the introitus and extending upward leaving only a shallow pit of a few centimeters to mark the site of the vagina externally (Figs. 1b and 1c). If the entire vagina is absent the cervix may also be absent and the uterus attached in the pelvis by a fibrous cord. Occasionally the vagina may develop normally while the cervix is absent or there is atresia of the cervical canal (Fig. 1c). In a uterus didelphys or a uterus bicornis obstruction may be present on one or both sides in any position for which it has been described in the single uterus (Figs. 3a, 3b, 3c and 3d).

In 11 of the 33 cases in this series the obstruction was of the congenital type and in 9 of these the anomaly depended on varying degrees of arrested development of the vagina (Tables 1A and 1B). In one there



Fig 5 Case 8 Hematometra and b lateral hæmatosalpinx from congenital atresia of the vagina

was an imperforate hymen in two a diaphragm persisted across the vagina above the hymen and in 6 there were varying degrees of vaginal atresia (Figs. 4 and 5). In two instances the anomalies were more complex (Table 1C). The patient in Case 10 aged 17 years had menstruated regularly since the age of 13 but she had suffered severe attacks of lower abdominal pain especially marked on the right side and sometimes associated with the menstrual periods. Pain was becoming progressively more severe and recently had been associated with vomiting and hallucinations. There was incomplete uterus didelphys (Fig. 6) in the left side of which was a normal outlet that had been responsible for the menstrual flow. The outlet in the right side however was occluded and hæmatometra had developed.

One case of true hermaphroditism (Case 11) is included in the series.<sup>1</sup> In this patient there was a uterus didelphys (Fig. 7) which communicated through the small vagina with the posterior male urethra at the verumontanum. The communication was so small however that it offered partial obstruction to the escape of menstrual fluid and caused a hæmatometra and a bilateral hæmatosalpinx. The symptoms were typical of hæmatometra but because of the communication with the posterior urethra there was also periodic hæmaturia associated with each attack of pain.

**Symptoms.** If there is congenital obstruction in the vagina uncomplicated by other





trial attack but it does not return to its previous dimension before the succeeding attack intervenes. In the presence of hæmatocolpos the pressure of this mass on the bladder may give rise to a moderate degree of frequency and burning on urination and occasionally to complete urinary retention (9-21).

More complex anomalies may modify the symptoms accordingly. When there is duplication of the uterus with obstruction of the outlet of one side only menstruation occurs regularly on the other side or the patient may become pregnant coincident with the development of hæmatometria on the other side.

#### THE ACQUIRED TYPE OF OBSTRUCTION

**Etiology.** The acquired type of obstruction is almost always in some portion of the cervical canal and is consequently not associated with hæmatocolpos. The obstruction usually follows either severe lacerations from miscarriage or difficult labor or it is a direct result of a plastic operation on the cervix. Other occasional etiological agents that have been reported are the wearing of a stem pessary over a long period of time (16) the application of radium to the cervix (17) fibromyomata obstructing the lumen of the cervical canal (7) and adhesions between the cervix and the wall of the vagina. Only rarely has cauterization alone of the cervix resulted in obstruction. In Case 15 (Table II) the obstruction followed the use of the cautery but was combined however with dilatation and curettage and removal of a specimen from the cervix for biopsy. In this instance the use of the cautery alone cannot be considered the etiological factor. In the aged it was pointed out by Cellhorn senile vaginitis may occasionally lead to the formation of obstruction in the vagina. As the epatients have usually passed the menopause hæmatometria and hæmatocolpos result only in some pathological process such as tumor which is producing bleeding.

In the congenital type the obstruction is almost always complete from the beginning but in the acquired type there is not infrequently a period during which the occlusion is only partial. The obstruction may quickly become complete or it may remain indefinitely as an incomplete type.

**Anomale.** the patient gives a history of complete absence of menstruation with the onset just prior to or at puberty of monthly attacks of pain and cramp in the pelvis and lower part of the back. The pain at first is moderately severe but with succeeding attacks it becomes more severe and of longer duration. The interval between the attacks are thereby shortened until the pain is almost continuous and frequently almost unbearable. Nausea and vomiting and varying degrees of prostration are sometimes present. Before puberty quantities of mucous secretion may collect and distend the genital tract above such an obstruction thus producing mild symptoms but with the onset of puberty these secretions are rapidly augmented and replaced by the products of menstruation and the symptoms soon become more severe.

The patient is often aware of a tender mass in the pelvis or in the lower part of the abdomen and the history is frequently given of enlargement of this tumor coincident with the onset of each attack of pain. The mass may decrease in size somewhat after each individual

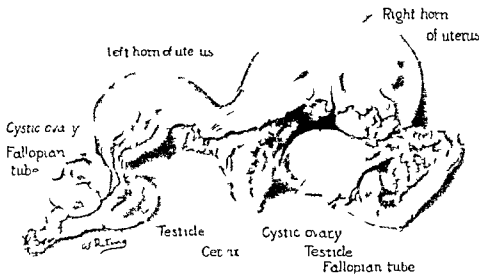


Fig. Case 17. Hematometra in a uterus dilated from a case of true bilateral hemaphroditism.

Twelve of the 35 cases in the series resulted from an acquired type of obstruction and 3 of the 6 followed some type of plastic operation on the cervix (Table II A). In three instances the operation included amputation of the cervix and in two instances it included dilatation and curettage alone and dilatation and curettage combined with biopsy and cauterization of the cervix. In one instance Case 17 an incomplete type of obstruction followed amputation of the cervix and developed into complete obstruction after the application of radium. In three instances trauma incident to miscarriage or labor was responsible for the onset (Table II C). In Case 21 there was slight hematometra which had not produced symptoms. It was noted incidentally in a uterus that had been removed for complete prolapse in a patient aged 62 years. Obstruction was the result of a submucous fibromyoma situated at the internal os combined with the reduction in the size of the lumen of the canal which is part of the normal involutionary process occurring after the menopause. In this case degenerating fibromyomata in the fundus were responsible for the bleeding. In Cases 1 and 3 the cause of the stenosis was not apparent (Fig. 8).

**Symptoms.** The age at which symptoms develop in the acquired type of obstruction is considerably greater than that at which they develop in the congenital obstruction, the average age in the former being  $36\frac{1}{2}$  years

and in the latter puberty. The oldest patient in the series was aged 66. After the menopause obstruction developing at the cervix produces hydrometra rather than hematometra unless there is bleeding from neoplasm in the fundus or from degenerating submucous fibromyomata as there was in this instance.

In the acquired types the patient gives a history of previous menstruation and usually dates the onset of symptoms from the occurrence of some one of the etiological agents mentioned. Since the obstruction is usually at the cervix hematocolpos with its accompanying urinary symptoms is usually absent. The character and periodicity of the pain is similar to that in the congenital type but it is often less severe because the obstruction at first is likely to be incomplete and because the uterus at this period in life is more completely developed and more readily distensible than at puberty.

If obstruction is incomplete the small opening which persists acts as a safety valve and the fluid is retained within the uterus until the pressure is sufficient to force it through this opening. Since only a small amount of the fluid can escape at a time while the reserve within the uterus is regularly replenished by the menstrual flow the result is an intermittent or continuous discharge. This is associated with periodic attacks of pain and enlargement of the uterus typical of the complete type of obstruction. The discharge often



Fig 8. Ca. Th. utru. and d. from p. t. nt. with ham. t. m. t. f. m. t. f. t. e. t. r. n. l. Et. ol. gy. not d. f. t. l. y. tal. l. h. d.

acquires an offensive odor the result of infection.

The general health of the patient remains unimpaired unless the symptoms are of unusual severity or prolonged duration when there is weakness and loss in weight. If infection develops there is elevation in temperature and pulse rate and increase in the number of leucocytes.

#### DIFFERENTIAL DIAGNOSIS

Dysmenorrhœa from other causes but especially the idiopathic type may be confused with hæmatometra. In no instance should hæmatometra be diagnosed unless definite obstruction can be demonstrated in some portion of the lower part of the genital tract and unless enlargement of the uterus can be demonstrated either persistently or intermittently in association with the attacks of pain. It is further essential for a diagnosis of hæmatometra that the retention of an appreciable amount of blood within the uterus be demonstrated at the time of operation.

inadequate and recurrence was frequent. Furthermore incomplete and often prolonged drainage not infrequently resulted in ascending infection of uterus and fallopian tubes and sometimes extension into the peritoneal cavity with the development of fatal peritonitis. It then gradually came to be recognized that this method of treatment was only applicable in certain types of cases and that in many instances more radical measures were not only necessary to accomplish a cure but safer.

In young patients especially it is desirable if possible to employ conservative measures in dealing with the pelvic organs. Unfortunately in the younger patients with hæmatometra the obstruction is practically always congenital frequently involving a large part of the vagina or is associated with other anomalies which make conservative treatment difficult or impractical.

In uncomplicated cases of hæmatocolpos with or without hæmatometra in which the obstruction is due to imperforate hymen or persistent membrane across the vagina free incision with irrigation of the cavity is the treatment of choice. In the uncomplicated cases which result from subtotal congenital atresia in which the uterus and cervix have developed normally and are attached to the vagina the drainage operation is also applicable. If conservative treatment fails infection is present or if the uterus and cervix have not developed normally or are attached to the vagina by a fibrous cord only hysterectomy should be performed and later in life should it be indicated a plastic operation can be performed to make a vagina.

In the presence of hæmato-salpinx on one or both sides conservative treatment by vaginal drainage is attended by added risk because of the danger of rupture of the tube if it is anchored by adhesions. As was pointed out by Carville and others in contracting down when thus rapidly emptied the uterus may produce sufficient traction on the distended anchored tube to rupture it. Further

TABLE J—HÆMATOCOLPOS HÆMATOMETRA AND HÆMATOSALPINX RESULTING FROM CONGENITAL TYPES OF OBSTRUCTION<sup>1</sup>

## A Congenital septum or imperforate hymen

C	Ag	H to y	Cl l i t	T m n t	R l t	C m m t
6	N t k m f t t f m thly t bd m l m p h k h d l q y bd m l g r y d t d d t t 3 y	B l b g m p f t t h y m p l f l d f y y t m l a m t d h a m a t l p	H y m f t y c f f s l d t d w l g t d f m g	C l e f l 6 y f t t g o o l h l h d m t t g g l y		
4	N t k m f t t d thly t t p l b e m g p thly m m l t d y d f q y d	D p h g m g s m b h y m c y t m p l t m p t o o p l	I f m m b f l l d l y f t t 3 w k l t p h y t t m y	D g f l t h k f l t f l 6 y l t e g l h l h	A t f l m m t f t h t s t b d o	
3	O s t f m thly t t a c k f p l p m c l g l g l p t m t g l d m g p t s p l f e d d t p d t h p e t t p f d h g	R m t f g l p t m l p g t d m t h p g t p t l t	V g l l g f l g m t f p p h y t t m y a f t e m t h	R y h l h f 2 y l t d d f m p y l e p h t	F t f l m m t m t f t t d d	

## B Vaginal atresia

4	5	N t k m f t t d m thly t c m p d t 7 m th	L g f m t m p l t m f h a m	V g l d g f o o m t h k h l t d f l t f k d t h d f m g	C o l f l m t h l t m t a t b m m l 6 m t h l t h l h g o o d	
5	3	N e m t r u t d p l w p l f l k n d b d m e t h m l d t t f b d d d p l u s 6 m t t d m p l u s 6 m t t d m	V l m p f t l y d l p e d m p l t t u l t f l g f g c y t m p l l l w p t f b d m	C m b d b d m l t t l d g b y b l d o o m t b l d	Two m t h l t t t w l l d d m t t d m l y t w d f f m p t t 3 y l t e	A m l f t h g t l w p t t t h m m b f t h f m l y
6	6	N m t r u t d m thly t t k f m p l p t o f b d m m l d f q y a d d y t t m d t n y l p p g f l t t m p t t	D f t l l b l t f g g l g d w t h c y t m b t h d	P h y t t m y	C l f l 7 y l t b t f l h l h d h p p l y m r r d	H a m t m t w t h b l t h a m t l l p c y t l t h
7	7	N m t r u t d m thly t t k f b d m l m p t w p m f l t t m p t p g d t 6 y	V g l t t l p g t w t h d m t y g	H y t t m y l l t l l p g t m y	C l t f l p m t h l t t h p t n t w g o o d h l h	H a m t m t d l f t h a m t l p t l t d d l d l t t
8	8	N m t t d m thly t t k o l b d m l p p g l y m l p t 9 m t h s	V g p t t t l a m l y t l g d d t t d t l e m t y g b t h t l e m	H y t t m y d b l t l p g t m y	C l e t f l	S t o f t e l t m t w t h h a m t m t d t l p h a m t l
9	8	N m t t d m thly t t k s l l w b d m l e m p d d m l g e t h y d t s m t h	I m p f t h y m t l f t d f p l m f g s t m t g h t d	H y t t m y	C l e t f f l	U t d b w t h d m t y h t h l t m l l h a m t m t g h t h a m t o s l f

## C Miscellaneous group

7	O t f m t t k t l p f l y o c t i w h m g e m l y m g h t d p g e m l y m g h t d p	C t m l l f d d d m h l f m l g d m p l s	P l t p e t w t h g h t h u g h t h d y f l t t c t y e m m c a t d	C o l m t h e v t f l g o o d h l h d m t r u t g l y	I m p l t t d d l o b y l f t d h m l l a m t m t l g h t d
4	R c u t t t k h a m l f t f d t f y t h	B l t l l e l d t s o m f m l c h t t e s b t k w m l p m l p t b p l m b l o o d t d t h t o r p m u t	I h y a t t m y l t k l y b t h l t f g l	C l l w l l 3 y l t	N m a l l y d l p e d t t r u d d l o b y s b t h h m l l t d w t h m t l b l o o d

All the p t t th group w m a i



TABLE II—Continued

C	Ag	H t r y	C l i d t	T m t	R k	C m m t
		M m m l f y b t 6 m ty th b tw th p b k h l b g d m l y f f w f l blood bd m l p t f t t 9	Syph: m l t n l t m t l g l	N	D l f m l l l t f m	C l l t d l t d t blood hamat m w l l f t h ham th th is
1	53	M t t m l t th g f 4 th d d m t p æ c f th g d d l t ci m f th d d l ped	N p >	N	D l f m m f th thyr d	O l f t t l t d d fill th ld bl d
All th p t t th g p m l pt C d 3						

pletely and as a source of prolonged drainage into the uterus and vagina remain as an open pathway by which infection may enter the peritoneal cavity. In the presence of hæmato-salpinx therefore and if the exact degree of development of the organs is not evident or if their exact relationship cannot be accurately determined beforehand abdominal exploration should first be performed in order to determine the feasibility of vaginal drainage.

More complex anomalies offer individual problems in treatment. Uterus didelphys is probably the most amenable of these anomalies to plastic surgery and when one side of the uterus is normal resection of the obstructed portion offers a good prognosis from the standpoint of the preservation of the menstrual function and the possibility of future pregnancy. This type of operation is attended by small operative risk. In the one case of hermaphroditism in the series complete hysterectomy offered the only choice of treatment.

In the acquired type of obstruction the principles involved in the treatment are the same except that radical operation may be more readily employed when the patient is approaching the menopause. As a rule if hæmatometra is slight and uncomplicated and especially if the obstruction is of the incomplete type dilatation of the stenosis suffices.

In selected cases following drainage of the uterus in this manner chemical hysterecomy as described by Masson and Ioucar would insure against recurrence and eliminate any associated intra uterine infection. This procedure is especially applicable if patients are near the menopause or if there is persistent discharge provided however there is no

involvement of the fallopian tubes. The uterus must first be returned as nearly as possible to normal size. If involution does not take place spontaneously after drainage it may be aided by the use of ergot and hot irrigations.

#### PROGNOSIS

If hæmatometra is allowed to go untreated a huge accumulation of fluid may result. According to Frank more than 35 liters have been recovered although the amount usually present varies from a few hundred cubic centimeters to 15 liters. With such an accumulation the pressure may become so great that spontaneous rupture occurs at the weakest point often the site of the obstruction. However the opening soon closes and there is either recurrence of the hæmatometra or pyometra develops. Spontaneous rupture occurred in Case 15 in the series and this complication has been reported by various observers. In some instances rupture has taken place into the rectum the bladder or the labia while in other instances the fluid has found an outlet into the peritoneal cavity through the fimbriated ends of the fallopian tubes.

In general it is true that the prognosis improves as the surgical treatment becomes more radical. In selected uncomplicated cases however the conservative type of treatment is followed by excellent results as to general health and the continuance of menstrual function.

The possibility of pregnancy occurring after hæmatometra remains questionable. Subsequent pregnancy has not been observed in any of the patients in this series and we have



TABLE II—Continued

C	Ag	H t y	Cl l d t	I t t	R h	C mm t
		M m l f t y b k h l b g l w by f e fl f l blood l t m bd m l p t g	Syph l æ m l t t l t g l	N	D l f f m l l	C l f f t t d l t d w th blood hæmat m w l f hæm t h g t th
58		M f 4 t h j æ m f g f d d l t p d	N p y	N	D d f f t h th y d m t	O l t f t d l t d t l fill th l b l i
All th p t t t h g p m d pt c d s						

All th p t t th g p m d pt c d s

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not been able to find any case reported in the literature in which it has occurred. It seems probable however that subsequent pregnancy should occur in cases in which the uterus is returned to its normal condition prior to the menopause and in the absence of prohibitive congenital malformations.

#### GENERAL DISCUSSION

The fluid contained within these cavities varies somewhat in character depending on the age of the patient and the site of the obstruction. If the obstruction is at the outlet of the uterus the retained fluid consists of the products of menstruation. In congenital atresia before puberty mucus may sometimes accumulate in large amounts. After the menopause if the accumulation of blood is the result of some disease process within the uterus pure blood mixed with clots in some instances will constitute the retained fluid.

If obstruction is in the vagina the cervical and vaginal glands contribute their secretions.

Prior to operative interference the fluid is usually sterile. Bell studied the chemical composition of hematomatocolpos fluid from two cases and found that the calcium content was high but that fibrin ferments and fibrinogen were lacking.

#### SUMMARY

Hematocolpos, hematometra and hematosalpinx may develop as the result of obstruction within the lower part of the female genital tract thus preventing the normal escape of the menstrual products or blood from the uterus. Such obstruction may be congenital in origin; it then usually involves the vagina and may be simple or associated with more complex anomalies of the genital tract. In other instances it may be acquired in which case it usually involves the cervix except in the aged and is frequently the result of trauma incident to parturition or follows plastic operations on the cervix. The required type of obstruction may be complete or incomplete.

The symptoms are typical. There is absence or cessation of the menses coincident with the appearance of attacks of severe pelvic or abdominal cramps usually occurring about once

a month. The attacks of pain tend to become progressively more severe and are associated with progressive enlargement of the uterus.

The treatment varies with the individual case. The genital organs should be preserved during the childbearing age when the risk of the conservative type of operation is not prohibitive. In the presence of certain complications vaginal drainage should be combined with abdominal exploration. In certain cases radical surgical measures should be adopted primarily.

#### BIBLIOGRAPHY

1. KAW H. R. A. cl. 11 tu. et t. of m. Cl. J. 909. 6. 64. wh. h. th. 11 m. T. o. f. t. f. m. wh. h. th. 1. t. al. ty. nt. d. f. e. bl. d. J. Ob. t. & 1. v. B. t. f. m. j. 9. 52. 4. 3. B. W. B. Th. n. t. f. hemat. l. p. o. fl. d. with 1. d. t. n. t. th. h. m. c. l. c. m. p. o. t. f. th. m. n. tru. l. h. g. d. th. f. th. m. l. g. u. l. d. l. y. g. d. th. d. ty. f. th. am. r. t. 1. th. h. r. a. t. f. th. l. tru. t. m. n. b. r. a. th. t. h. th. d. l. p. m. e. t. f. l. g. t. g. th. a. port. f. three. 1. m. t. l. p. P. K. So. M. d. Ob. t. d. 1. v. n. S. t. q. i. p. t. 34. 44. 4. B. R. z. c. Mém. l. l. d. t. prod. t. p. 1. t. d. d. i. m. tru. l. h. g. d. med. 44. 5. l. 9-5. 433. 46. 12. 4. 43. 5. B. R. I. L. E. O. V. D. of Small D. m. t. A. m. l. N. Y. k. I. d. l. b. 9. 672. pp. 6. C. R. Impe. f. t. d. amé. bee. H. m. t. l. m. p. e. t. p. pe. to. l. t. te. B. l. r. t. m. p. e. S. t. l. i. 40. 1. 306. 3. C. H. M. R. l. M. f. m. t. gé. t. l. (tér. b. l. o. u. re. h. m. t. m. e. t. n. l. t. r. a. l. ) h. e. j. fill. 1. y. n. m. e. l. o. 8. 85. 9. C. H. E. c. H. A. R. V. E. Y. Imp. f. t. d. l. t. r. u. 1. b. t. t. l. i. h. g. d. m. e. d. 8. 9. 6. 0. 6. 9. C. V. I. M. R. A. f. r. t. d. m. n. I. m. t. t. 7. 4. D. c. O. l. 7. 4. pl. h. g. e. d. r. d. l. t. ru. t. l. 8. 9. U. t. e. 5. 5. g. d. l. l. A. t. d. l. m. D. f. l. t. t. B. l. t. m. c. m. S. t. d. P. 8. 4. D. 3. H. m. t. n. t. K. d. chr. 8. 9. 6. 7. 6. 8. 3. I. n. F. H. M. of. g. n. l. t. develop. m. t. f. t. l. g. n. t. l. o. g. h. e. m. t. m. e. t. r. a. J. Am. M. A. 9. 1. C. 3. 3. W. l. d. M. m. a. n. b. 4. F. N. H. R. T. D. C. Pt. W. l. d. M. m. a. n. b. 1. b. d. I. l. ad. l. p. J. B. L. pp. t. t. Co. 9. 3. 665. pp. 5. I. R. R. T. C. l. l. l. O. b. t. t. l. P. t. h. l. 1. y. N. Y. k. D. Appl. t. a. d. C. 9. 536. pp.

- 16 GARDNER WILLIAM A case of hæmatometra Mon  
treal M J 1900 xiv 57-58
- 1 GELLHORN GEORGE Hamatocolpos hamatometra  
and hæmatosalpinx in a woman of seventy four  
year Surg Gynec & Obst 1917 xiv 37-42
- 8 Idem Hæmatometra due to radium Surg Clin N  
Amer 1921 ii 10-1,08
- 19 GOULLIQUET M Menstruation et aménorrhée dou  
loureuses par malformation utérine Lyon chir  
1909 ii 20-3
- 0 GUTIERREZ A Hæmatometra and appendicitis Ab  
stracted J Am M Ass 1921 lxxvi 619
- 21 HARTHILL J T A case of retained menses relieved  
by operation Brit M J 1910 i 71-76
- 22 HAWORTH J K Retention of urine due to hæma  
tocolpos and hæmatometra in a child Brit M J  
1921 163
- 3 HORROCKS PETER A case of concealed menstua  
tion with remarks on treatment Lancet 1903 i  
47 1250
- 4 JONES W C Report of a case of hæmatometra  
New Orleans M & S J 1925 lxxviii 95-96
- MACLEAN FWTN Dysmenorrhœa hæmatometra of  
one horn of uterus bicornis J Obst & Gynec  
Brit Emp 1911 xv 18-19
- 26 MASSON J C A case of true hermaphroditism Am  
J Obst & Gynec 93 ix 81-86
- 27 MASSON J C and LOUCAR H O The use of zinc  
chloride in gynecology Am J Obst & Gynec  
1925 x 35-364
- 8 MCFREDITH W A A case of hæmatometra associated  
with a degenerating fibromyoma treated by supra  
vaginal hysterectomy Tr Obst Soc London 1888  
xxix 4 2-48
- 29 MONDY S L C Retained menses in a child of four  
teen and a half years Edinburgh M J 1910 ix  
541-542
- 30 OLDHAM H Sur la dysménorrhée London M Gaz  
1846 iii 919-9,0 Abstracted Arch g n de méd  
1847 lxxiv 371-375
- 31 PERSOL G A Human Anatomy Philadelphia  
J B Lippincott Co 1913 ii 2010-012
- 32 IURSLow C E A case of unilateral hæmatoalpos  
hæmatometra and hæmatosalpinx J Obst &  
Gynec Brit Emp 1922 xxiv 643
- 33 OUCÉNU and LE SOURD ÉTIENNE Des opérations con  
servatrices dans le traitement des utérus didelphes  
à corps indépendants Rev de chir 1906 xxxiii 1
- 34 SIKORA PIERRE Indications et procédés opératoires  
dans le traitement de l'hématométrie Presse méd  
1907 xv 503-506
- 55 SPARK J N Acute torsion of normal appendages  
with hæmatosalpinx J Obst & Gynec Brit  
Emp 1911 xiv 258-60

# CLINICAL SURGERY

FROM THE SURGICAL CLINIC OF TROISSON & HABIKLP

## THE BILLROTH I RESECTION OF THE STOMACH

By DR. VICTOR ORATOI, D. I. L. R. C. A.  
J. I. L. A. h. I. I. I. A. H. I.

ALTHOUGH the etiology of stomach or duodenal ulcer is still not definitely established, Professor Haberer's practical experience, which began when he was a student in the Berlin surgical clinic together with the teachings of modern research, have established the fact, namely, that resection of the ulcer together with the pyloric third of the stomach is essential for permanent cure (1 to 17). We may therefore choose either the Billroth I or the Billroth II operation.

Since 1911 Haberer has considered the Billroth I the operation of choice and has used this method in 100 of his last 1000 resections of the stomach. It is only through the use of the Billroth I patients that the best physiological and clinical relations are reestablished. The most successful immediate and late results are obtained from this operation, which is the shortest one to perform. Moreover, peptic jejunal ulcers occur rarely following the Billroth II operation and are seldom seen after gastroenterostomy and pyloric exclusion, in that this type of operation has had to be abandoned.

### INDICATIONS FOR OPERATION

*Chronic ulcer.* All chronic calloused stomach and duodenal ulcers which medical treatment has failed to cure permanently should be resected. Practically every diagnosis of chronic calloused ulcer in our clinic has been confirmed by X-ray by Dr. Ichel of the Central Roentgen Institut. He has specialized in X-ray of the stomach and duodenum so that he can visualize and localize ulcer niches as small as millet seeds.

All acute non-calloused ulcers are treated medically.

When the ulcer is in the pyloric region, the Billroth I operation is indicated. When the ulcer is in the duodenum, the Billroth II operation is indicated. When the ulcer is in the jejunum, the Billroth I operation is indicated. When the ulcer is in the ileum, the Billroth I operation is indicated. When the ulcer is in the cecum, the Billroth I operation is indicated. When the ulcer is in the sigmoid, the Billroth I operation is indicated. When the ulcer is in the rectum, the Billroth I operation is indicated. When the ulcer is in the anus, the Billroth I operation is indicated.

*Ulcer complications.* Perforated ulcers are resected if possible and if the patient's condition will permit it. When resection is impossible the ulcers are simply sutured over and jejunostomy is performed if needed. The peritoneal cavity is sponged out and closed without drainage (1 and 17).

Surgery is delayed in cases with acute ulcer hemorrhage and if indicated transfusion administered.

Blood transfusion together with glucose and inulin administered intravenously is indicated before operative treatment in patients exsanguinated from chronic ulcer hemorrhage.

Inasmuch as all chronic calloused ulcers are resected in the Haberer clinic, their mortality percentage, which I estimate at about 6 per cent (7) for prepyloric and high as 10 per cent (15) need not be considered.

Peptic jejunal ulcer, which cannot always be confirmed roentgenologically, are a definite operative indication. Even in these cases after critical resection the Billroth I operation should be used if possible because there is no ulcer predisposition and in occasional cases a peptic jejunal ulcer will recur. In the case of the great importance to include the pylorus in the resection because a similar condition to pyloric exclusion is otherwise established (5, 6, 9).

After a gastroenterostomy many cases without jejunal ulcers still have symptoms of the original ulcer, do not heal and require another laparotomy. In the case of a Billroth I, one after the gastroenterostomy has been spared.

*Adenoma of the stomach.* The Billroth I anastomosis is as rapid as after the most radical resection for carcinoma. The duodenum is generally not involved by the carcinoma and even with a subtotal stomach resection the Billroth I can be completed easily. The rapidity with which this operation can be finished is of great value to the cachectic carcinoma patient. As there is

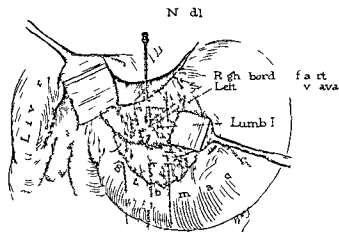


Fig. 1 Splanchnic anesthesia. Liver retractor placed by the liver retractor. Stomach pulled down. Point of the needle upon the spinal column with the aorta pushed to the right.

little danger of postoperative hemorrhage the submucosa hemostatic sutures may usually be omitted. The serosa must be very exactly sutured because the adhering ability of the peritoneum is markedly reduced in carcinomatous patients. This danger is however equally great with the Billroth II operation.

#### PRE-OPERATIVE PREPARATION

The patient should stay in bed at least 5 or 6 days prior to the operation. Whenever possible symptoms of acute irritation should be allowed to subside. The stomach is emptied the night before the operation and again immediately before the operation by means of an extreme Trendelenburg position which allows complete emptying of the stomach through the stomach tube. Hemorrhage contra-indicates this procedure but perforation does not. One hour before the operation  $\frac{1}{2}$  centigram of morphine is given followed by 1 centigram of morphine and 1 centigram of atropin three quarters of an hour later.

#### OPERATIVE TECHNIQUE

1. *Anesthesia and opening of the abdomen.* Subfascial and subcutaneous infiltration with  $\frac{1}{4}$  per cent tutocain is made along the costal margins and then down to the umbilicus. After the abdomen has been opened Braun's splanchnic anesthesia is obtained by injecting 80 to 100 cubic centimeters of  $\frac{1}{4}$  per cent tutocain (14-19).

Ether anesthesia is used when especially desired by the patient or if the patient is young or excitable (3). The most exact hemostasis is essential in opening the abdominal wall.

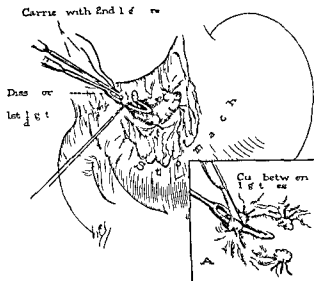


Fig. 2 Dissection of the left gastric artery. Stomach pulled down. Lesser omentum split by scalpel. Liver pulled upward by retractor. Dissector pushed into the slit in the lesser omentum then out elevating the left gastric artery and vessels along the lesser curvatures upon the dissector ready for ligation.

2. *Exploration of the case.* The stomach and duodenum are examined carefully but without tissue damage. Adhesions of the omentum covering the ulcer are freed by means of sharp scalpel dissection. Finally the posterior wall of the stomach and duodenum is palpated through incisions in the lesser omentum and the gastrocolic ligament. The pancreas, gall bladder, biliary ducts and appendix are also examined. All large lymph glands are critically considered.

Orientation in the abdomen may become very difficult because the lesser omentum may appear as a shrunken board-like loop, the hepatoduodenal and gastrocolic ligament may be altered by edema, the head of the pancreas may have markedly swelled lymph glands. Mobilization of the stomach may be limited further by the frequent penetrations into the pancreas as found in 31 per cent of our cases (18) or into the liver and anterior abdominal wall. The entire planning of the subsequent operative procedure depends upon clarifying the situation as found in such cases.

3. *Preparation for resection.* The most essential prerequisites for successful ulcer resections are exact hemostasis and preparation for resection with a minimum of tissue damage. According to Haberer adequate mobilization is and remains most important. The first part of the duodenum and the pars pylorica of the stomach is resected regardless of whether the ulcer is in the duodenum or the center of the stomach. The Billroth I anastomosis is then made possible when the stom-

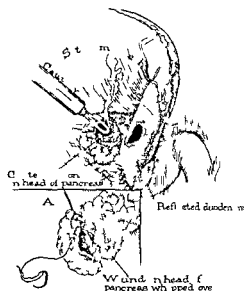
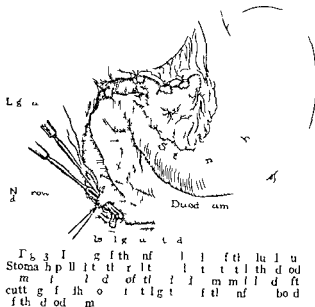


Fig. 4. C. t. z. a. t. o. p. n. t. to. t. t. h. p. e. a. f. l. n. r. t. w. o. l. p. t. h. y. t. r. d. d. p. e. to. d.

each duodenum loop is elevated so as to permit approximation of the pars media of the stomach and the first part of the duodenum.

The blood vessels in the lesser omentum and gastrocolic ligament should be ligated with the most careful hemostasis. The main branches of the curvature vessels are first double ligated at the future line of resection of the stomach and duodenum. This will naturally fall cardinal to a stomach ulcer and aboral to one of the duodenum. After ligation of these main vessels ligation of the remaining vessels in the lesser omentum and gastrocolic ligament can be finished with surprisingly few ligatures.

As a rule von Haberer begins the dissection where it is the most difficult. In a duodenal ulcer the duodenum is freed first and in a gastric ulcer the stomach. The pars pylorica is the starting place only in the most difficult cases and then the ulcer is attacked. This type of procedure followed by immediate freeing of the ulcer accomplishes the desired objective in the most rapid fashion. From our extensive experience this rapidly makes it the method of choice to be used whenever possible.

The separation of the lesser omentum, gastrocolic ligament and vascular adhesions is accomplished by cutting between two interrupted ligatures. These are introduced through blunt aneurism needles guided by Kocher dissectors of the appropriate size modified by von Haberer. By this technique of multiple interrupted ligation it is possible through sharp scalpel dissection to free quickly the non vasculated parts of

lesser omentum of gastrocolic ligament as well as the firm adhesions which usually lie in the hepatoduodenal ligament or anterior duodenal wall. Naturally the method of procedure will vary according to altered findings. When perforation has not yet occurred the stomach is readily pulled down and the lesser omentum incised in the pars flaccida. The left gastric artery is doubly ligated at the level of the stomach corresponding to this incision in the lesser omentum through which the right gastric artery can also be reached to be ligated. Then the peritoneal covering of the lower border of the duodenum is incised. From this starting place the inferior edge of the pars superior and horizontalis of the duodenum are dissected free by keeping close to the duodenal edge. The small Haberer sound is used to isolate segments which are ligated separately. The pancreaticoduodenal artery on the head of the pancreas is still not ligated and is caught near the stomach antrum where it arises from the right gastroepiploic artery. The left gastroepiploic artery is ligated after the gastrocolic ligament is severed. To tie the remainder of this ligament usually require but a few ligatures.

When a duodenal ulcer is present and the hepatoduodenal ligament is indurated it is above all essential to employ wide dissection of the superior duodenum. Only through this step can enough normal duodenum be freed from the contracted periduodenal adhesions to suffice for the proper execution of the Billroth I operation. The anterior wall of the duodenum is freed by

sharp dissection of the adhesions. This permits the duodenum to climb out of its indurated adhesions so that its superior and inferior circumferences can be freed in the typical manner already described. Finally the posterior surface is prepared and here normal serosa is an absolute prerequisite for the Billroth I resection.

When a stomach ulcer penetrates into the pancreas the stomach and duodenum are first freed above and below the ulcer so that only the site of penetration into the pancreas remains adherent. The adherent perforation is then burned out of the indurated pancreas by a platinum cautery, care being exercised to avoid if possible opening the ulcer. The resulting pancreatic callus is then covered by suturing it over very carefully with the pancreatic capsule. Injuries to the head of the pancreas should be very carefully avoided. In cases of this type the ulcer may be opened earlier. This may be done without danger provided the adjoining tissues are walled off.

A similar technique may be used in penetrations into the liver, colon or the anterior abdominal wall, i.e. cauterization of the base of the ulcer and exact suturing over of the serosa at the site of perforation.

**4. Resection and anastomosis.** The instrument used is a double clamp which has been developed in von Haberer's clinic (14). It consists of a stomach and a duodenal clamp which are held in the desired relation hip by a third clamp. The suture material is fine silk for the seromuscular layers and fine catgut for the mucosa. The posterior serosa is sutured by very small semi-circular needles—the so-called Billroth needles which are slightly larger than the needles used for blood vessels. In addition Kader needle holders of two different sizes and copper flexible retractors of varied size are used.

The duodenal clamp is fastened just distal to the ulcer on the freed healthy duodenum. If there is the slightest doubt that an ulcer may still be present further down on the posterior duodenal wall the clamp is not locked until the duodenum is opened and its condition definitely established. However as will be later demonstrated the duodenal clamp is not used in many cases and only through the omission of the clamp is it possible to approximate and suture after radical resection.

The duodenal end of the stomach is clamped with a soft Doyen clamp to avoid any spilling of its contents. The peritoneal cavity is then carefully walled off and the duodenum is severed with a cautery about  $\frac{3}{4}$  to 1 centimeter from the

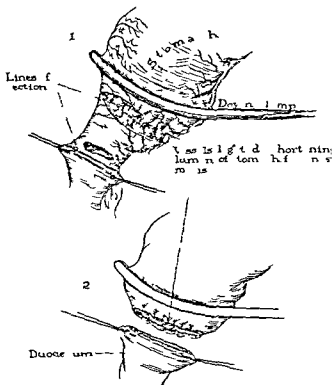
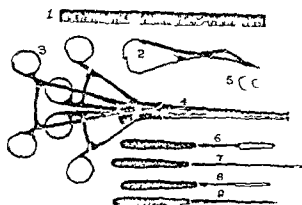


Fig. 5. Removal of the duodenum. The stomach closed above the pylorus by a Doyen clamp. Two stay sutures in the duodenum are held by forceps, and the freed duodenum is elevated. The anterior wall of the duodenum has already been opened by the cautery. Inspection of the posterior duodenal wall with the ulcer already exposed. 2. Billroth I showing the suture of the posterior wall and the catgut hæmorrhagic sutures.

duodenal clamp the pyloric stump is then covered with a laparotomy sponge after elevation of the stomach the stomach clamp is fastened in the regions of the pars media sliding the clamp from the greater curvature toward the lesser curvature. The two clamps are next united by the third with the stomach extending out over the left border of the abdominal incision—toward the surgeon's right—so that the posterior surfaces of the stomach and duodenum may be widely approximated.

As a general rule it is possible to stretch the duodenum wide enough through stay sutures so that its inferior and superior edges to fit the transverse cut of the opened stomach. The closely approximated posterior seromuscular interrupted sutures are next inserted the fine Billroth needles and the small Kader needle holder being used. The seromuscular layer of the posterior wall of the stomach is cut about 1 centimeter away from the row of Lembert sutures down to the submucosal blood vessels which are ligated by interrupted catgut suture ligatures. This procedure decreases postoperative hemorrhage. The



1. Stomach 2. Duodenum 3. Sutures 4. Sutures 5. Sutures 6. Sutures 7. Sutures 8. Sutures 9. Sutures

catgut hemostatic sutures of von Haberer are very similar to the hemostatic sutures used by Heidenhain in trepanation. They narrow the lumen of the stomach so that it becomes possible to do an end to end anastomosis with the duodenum even in those cases which in the beginning presented a marked disproportion. The sutures are left long.

The stomach is then moved to the patient's right over the taut hemostatic sutures which are covered by a lap sponge and a flat 3 centimeter retractor to prevent their becoming entangled in another Doyen clamp later used. The seromuscular layer of the anterior wall of the stomach is now incised as was the posterior wall. This incision is about 3 to 4 centimeters from the von Haberer stomach clamp. It is important here to be far enough away from this stomach clamp so that there remains sufficient anterior wall of the stomach to permit the insertion of the final layer of anterior wall. Lembert sutures without tension and without the necessity of removing the stomach clamp. The submucosal blood vessels are ligated by interrupted catgut sutures in the same manner as were those of the posterior wall.

The stomach segment to be resected is next closed by another Doyen clamp on its oral border and secured by electric cautery between the two clamps (von Haberer stomach and Doyen clamps) about 4 millimeters above to the hemostatic sutures. This is done by first burning a little bit in the mucosa through which an anatomical forceps is inserted into the stomach lumen and then the mucosa of the anterior wall can be easily burned through between the spread blades of the forceps without injuring the adjacent

tissues. The stomach is again turned over to the left and a flat retractor is inserted into the stomach lumen against the still remaining mucosa of the posterior wall which is burned through so that the resected segment is free. The catgut hemostatic sutures are now cut.

First the posterior and then the anterior walls are sutured by a continuous catgut suture which includes all of the layers of the stomach and duodenum; the beginning and end of this suture are tied together.

The anterior seromuscular suture line is completed by interrupted silk sutures which seek to overinvaginate the duodenum with the seromuscular layer of the stomach. Finally the duodenum fits into the stomach as the stalk of a mushroom fits into its pileus. This end-to-end Billroth I anastomosis with all of the stomach lumen entering into the anastomosis is generally over two fingerbreadths long but we have never seen stenosis.

It is only rarely possible to complete the anastomosis with both clamps in situ. As a general rule it is necessary to remove the duodenal clamp in order to be able to finish the anterior seromuscular suture. In a certain percentage of cases the duodenal clamp must be removed after the duodenum has been stretched to match the stomach lumen by the superior and inferior stay sutures so that the posterior serosa sutures can be inserted. In many cases the duodenal clamp must be abandoned. Here before the duodenum is either opened or cut the two stay sutures are inserted and held tautly elevated to prevent spilling of the duodenal contents. Moreover any pressure upon the duodenum must be avoided.

5. Closure of the abdomen. The abdominal wall is closed in layers: the peritoneum by continuous silk, the fascia with interrupted silk and the skin with clamps.

6. End to side modification of the Billroth technique (Haberer Modification). In those cases in which it is impossible to obtain a good serosa on the posterior duodenal surface the Billroth I operation is contraindicated. Instead the duodenal stump is buried by being covered with two rows of sutures: the first being continuous catgut followed by silk Lembert sutures which include the pancreatic capsule to cover the duodenal stump. There now still remains the possibility of obtaining the advantages of the Billroth I anastomosis by utilizing the end to side von Haberer modification. The duodenum is mobilized markedly by means of the cutting of the peritoneum laterally and to the right of the pars descendens of the duodenum (vena cava is now

exposed) Then the transverse cut edge of the stomach is anastomosed to the pars descendens of the duodenum with two rows of sutures either terminolateral or end to side

End to side anastomosis is contra indicated in many cases because of dense adhesions or unfavorable position of the head of the pancreas The antecolic Billroth II resection together with a Braun's entero-anastomosis then becomes the operation of choice Because of limited space it is inadvisable to discuss further the modifications of the Billroth I technique which may be needed in ulcers of the cardia in perforated ulcers in hemorrhage or other complications

#### POSTOPERATIVE TREATMENT

After operation nothing is given by mouth for the first 12 to 36 hours or as long as the patient is nauseated weak tea in very small amounts being the first food Thirst is combated by physiological salt solution and glucose *per rectum* by the drip method Black coffee is included in these enemata for stimulation

Patients in shock or very emaciated or starved patients are given intravenously 50 to 150 cubic centimeters of 50 per cent glucose together with 40 to 80 units of insulin (8)

Hemorrhage from the stomach after operation has practically disappeared since we have been using the catgut hæmostatic sutures The patient is kept on a liquid diet for 7 days and remains in bed 14 days About 17 or 19 days after operation the patient is fluoroscoped In cases of emesis or moderate gastric atony the stomach is washed out Threatened lung complications are treated by forced deep respiration carbon dioxide inhalations camphor and lobelin morphine is given for pain As a prophylaxis against pneumonia Bier's ætherpsicain afenil and heart stimulants such as digipuratum or digitalis are used Cases of beginning pneumonia receive carbon dioxide inhalations 10 cubic centimeters of camphor in oil 80 to 800 cubic centimeters of 4 per cent colloidal iron sugar solution intravenously as well as the customary therapy Before discharge from the hospital all patients are given definite dietary directions and are instructed to return for control examination once a year

#### EARLY POSTOPERATIVE COMPLICATIONS

1 Peritonitis secondary to separation and leakage at the suture line is a rare but usually fatal complication It is found occasionally in very cachectic patients or may result from digestion of the sutures in those cases in which the pancreas—especially the head—has been traumatized by

faulty technique Separation of the suture line in Billroth I secondary to excessive tension can be avoided if the duodenum is properly prepared and if the operative indications are carefully applied

2 Subphrenic abscesses and empyema are much less common after a Billroth I than after a Billroth II operation These complications are curable if diagnosed early enough and drained

3 The most common complication is pneumonia which occurs just as frequently after local as after general anesthesia Its etiological basis may be either an existing bronchitis bronchiectasis or tiny lung emboli Prophylaxis consists of minimizing tissue damage and limiting evisceration with resulting cooling of the intestines Gangrene of the lung which may follow accidental aspiration during general anesthesia is treated by salvarsan

4 Prior to the use of the hæmostatic sutures of the submucosal blood vessels hæmorrhage was relatively frequent but it has now practically disappeared Treatment consists of abstinence from food ice bag to the stomach irrigation of the stomach with from 10 to 20 liters of  $\frac{1}{2}$  per mille lapis solution calcium gelatin and serum or blood transfusion

5 Brown atrophy of the heart from chronic malnutrition may lead to failure of the circulation Its existence can only be suspected but not definitely diagnosed in exsanguinated patients or those who have suffered from chronic ulcers for many years

6 Fatal emboli did not occur in this series of cases

7 A mild postoperative parotitis will occasionally occur after gastric resection for ulcer

#### LATE COMPLICATIONS

The following late complications may be decreased by the use of the Billroth I type of resection

1 In cases of resection in which there are multiple ulcers (12) of the duodenum it is easy to overlook one which leads to the so-called apparent recurrences Careful anatomical exploration which is possible in the Billroth I resection will decrease this oversight and eliminate the apparent recurrences

2 The scar recurrence is found after the Billroth I resection when the duodenum used in the anastomosis is either pathologically scarred or the ulcer not completely healed Proper evaluation of the anatomical findings at operation will limit the Billroth I resection to the indicated cases and eliminate this error



3 A small percentage of patients complain of so called small stomach but as a general rule the early postoperative rapid or precipitate emptying of the Billroth I stomach stump is gradually replaced by normal stomach emptying

There was a 4 to 5 per cent postoperative mortality and 96 per cent cures in a series of over 1200 Billroth I resections which included all difficult cases and patients of all ages (11)

# BIBLIOGRAPHY

- HÄR WENDEL W H SCH 90  
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 3 Id m I d t on t llug f d h u g B h nd  
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## FROM THE ORTHOPEDIC SERVICE MASSACHUSETTS GENERAL HOSPITAL

## ARTHROTOMY OF THE HIP

BY NATHANIEL ALLISON M.D. F.A.C.S. BOSTON

THE hip joint is deeply placed and is surrounded by numerous muscles. The psoas and iliacus are in front of the articulation. Behind it are the quadratus femoris, the obturator internus, the two gemelli and the piriformis. To the outer side lie the gluteus medius and minimus and rectus, and to the inner side are the pectineus and obturator externus.

The hip joint has an exceedingly strong capsule made up of white fibrous tissue which is thickest in front. Its reinforcing ligaments are the strongest in the body and include the iliofemoral, the ischiofemoral and the pubofemoral ligaments, the pubofemoral and the iliofemoral forming what is known as the Y ligament of Bigelow. The thinnest part of the capsule lies between the iliofemoral and pubofemoral ligaments and here the joint cavity often communicates with a small bursa which lies below the psoas muscle. The hip joint capsule is also weak where it is covered by the obturator muscles.

The upper border of the great trochanter is on a level with the center of the hip joint. A vertical line extends from the anterior superior spine of the ilium to the most prominent part of the tuberosity of the ischium, running across the center of the acetabulum and passing over the top of the great trochanter.

The head of the femur lies just below and to the outer side of the central point of Poupert's sign.

There are descriptions in surgical literature of many different methods of carrying out the operation of arthrotomy of the hip. The operation has been recognized as an important one since a remote period of surgical history. The names of such surgeons as Isidore Sedillot, Percy Roux, Langenbeck, Lucie Barber, Kocher and many others are associated with methods of opening the hip joint. Indeed Farabeuf (1841-1910) assembled in his treatise on operative surgery 18 different methods of performing the operation.

In times past the operation of arthrotomy of the hip was done in desperate haste for desperate conditions. Surgical skill reached its maximum of deftness in doing the operation and considerable pride was taken in stop watch records. The necessity for haste was very urgent for excision of the

hip was attended by terrible mortality. Treves gives statistics collected by Otis in 1891 showing a death rate of 90.9 per cent following gunshot wounds. The same statistics show that the mortality without operation was 98.8 per cent. When amputation was promptly done the mortality was 83.3 per cent. Bryant in 1887 stated that when the operation of hip resection was done for disease the mortality ranged from 15 to 45 per cent. In gunshot wounds death occurred in 95 per cent from primary operation, in 91 per cent from infection and in 90.5 per cent following secondary operation. Present day surgical methods have made the operation less lethal in character and have vouchsafed to the surgeon a greater sense of security than was felt by the past generation. Nevertheless the operation of arthrotomy of the hip remains a major surgical procedure, one not to be undertaken lightly and one requiring surgical experience and judgment as well as skill and deftness in the handling of tissues.

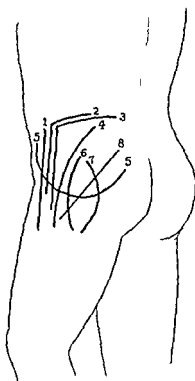


FIG. 1. Some of the approaches to the hip joint: 1, anterior; 2, Smith; 3, Petersen; 4, Kocher; 5, Ollier; 6, Sayre; 7, Bryant; 8, Ober.

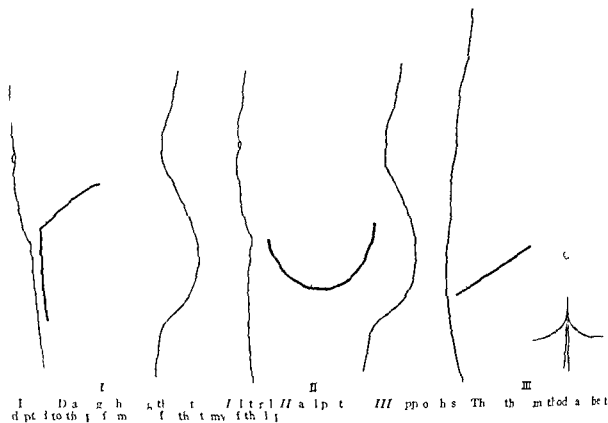


Fig 3 Th t ro app o h alled th Sm th P t pp h

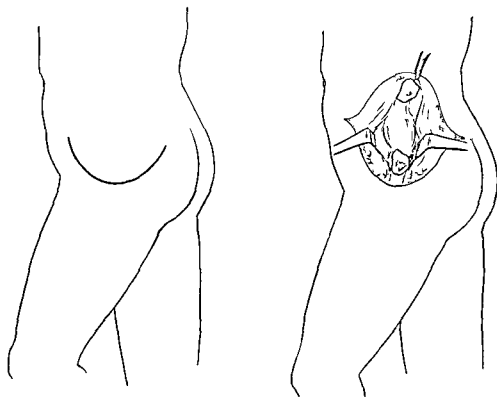


Fig 4 The lateral approach described by Olier

Operations on the hip joint have various objects drainage of an infection repair of a fracture or plastic reconstructions upon the head and neck of the femur or the acetabulum. In some cases it may be necessary to excise the joint or create an ankylosis or attempt to re-establish motion in an ankylosed hip. At times the hip may be flail or wobbly because of paralysis and a stabilization of the joint may be needed. Other objectives of surgical treatment also may arise. In consequence several useful methods of approach to the hip have been devised and it is of great importance in each case to select the method of approach which will best allow the accomplishment of the end required.

Arthrotomy of the hip should be done only with the full realization on the surgeon's part of the importance of all the details of operative technique and after care. The surgeon must be fully cognizant of the dangers in general and in particular to each individual patient. He must know exactly why when and how the operation should be performed.

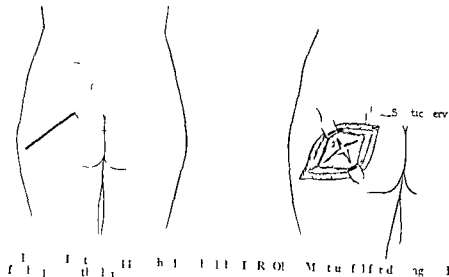
The dangers in general encountered in arthrotomy of the hip are those common to any serious surgical procedure performed upon patients who as a rule are not in good physical condition. Consequently the operation must be done with reasonable speed and with due regard to the tissues. Severe traumatism of soft parts and of bone tissue

must be avoided. Surgical shock from trauma and loss of blood are the chief dangers. It goes without saying that operative infection is a most disastrous result insuring always a long period of serious illness with high mortality. Nowhere in surgery are a careful technique and a rigid asepsis more necessary.

As a rule arthrotomy of the hip should be done only for urgent reasons such as pain in the hip or inability to walk, or in order to stabilize a tuberculous hip or to drain an acute infection of the joint.

If a condition warrants operative interference the operation should be done as soon as possible after the conditions have been properly weighed and studied. Satisfactory roentgenograms should be obtained before operation is decided upon.

Among the lesions which may require hip arthrotomy are the following: acute infections of the hip joint; tuberculosis of the hip in adults—so-called hip fusion; fracture of the femoral neck—reconstruction or bone plastic; unreduced traumatic dislocations of the hip; arthritis of the hip with painful motion or loose bodies; disarticulation or amputation for sepsis; ankylosis of the hip; so-called arthroplasty; unreduced displacement of the upper femoral epiphysis; obscure arthritis demanding tissue examination; congenital dislocation in young adults or adults; and stabilization of the hip in paralysis notably poliomyelitis.



Other conditions and variations of lesions just mentioned may also make it necessary for the surgeon to proceed to arthroplasty of the hip

#### METHODS

There are three useful methods of approach to the hip: the anterior, lateral and posterior and it is important to select the method which will best favor that which is to be accomplished after the hip is opened.

We have used in the Orthopedic Service at the Massachusetts General Hospital that the anterior approach is best suited to these cases: 1. Hip lesion in which a disarticulation of the femoral head is necessary and in which it is probable that some type of osteoplastic operation is indicated upon the femoral head or acetabulum or the margins of the latter. Therefore the anterior approach is to be used in the following lesions: tuberculosis of the hip in adults; septic hip; fusion; unreduced traumatic dislocations of the hip; arthritis of the hip with painful motion; loose bodies; ankylosis of the hip; so-called arthroplasty; congenital luxation in young adults or adults; and stabilization of the hip in paralysis, notably poliomyelitis.

We have found also that the lateral approach is best in fracture of the femoral neck—reconstruction or bone plastic—and in disarticulation or amputation for sepsis.

We have made use of the posterior approach in the following lesions: acute infections of the hip joint; unreduced displacement of the upper femoral epiphysis; and obscure arthritis demanding tissue examination.

Each method of approach has certain advantages in some lesions and disadvantages in others. For instance, the removal of the greater trochanter major

which is necessary in the lateral approach is not the best approach for drainage of the joint in acute infections. For obvious reasons, the posterior approach is best in this instance. Likewise the anterior approach is not advisable for reconstruction operation in ununited neck fracture because in this instance a bone plastic must be done on the greater trochanter. Obviously the lateral approach is indicated in this lesion. Furthermore, neither the lateral nor the posterior approach will give sufficient exposure for bone plastic measures in the neck and head or the acetabular margin—here the anterior approach is best. Of the three methods of approach, it is fair to say that the anterior is the most difficult and damaging, next the lateral and least damaging in the posterior. In consequence, it is beyond question better to use the posterior approach in all operations done for the purpose of tissue removal for diagnosis and in all attempts to establish drainage in infections of the hip.

#### PREPARATION

The patient's general condition should be the best possible under the circumstances before operation is done. If possible, several days of rest with good sleep should be secured. The skin should be shaved and cleansed with soap, water, ether and alcohol before the operation. The ordinary pre-anesthetic precautions should be observed. The skin over the entire hip region should be painted with iodine and the operative field carefully dried with sterile coverings. It is always necessary to manipulate the leg and thigh during the operation; consequently, it is essential to cover the patient so that the hip on the side to be operated upon may be moved without danger.

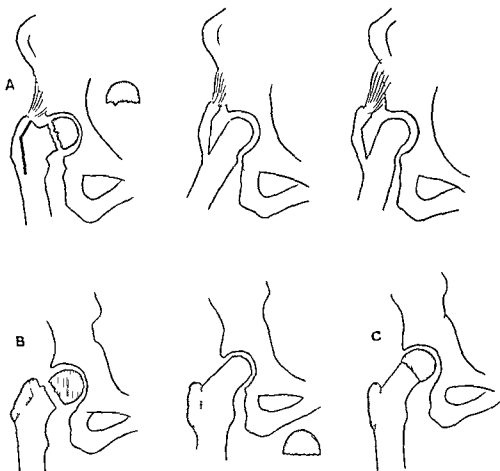


Fig 6 Type of reconstruction operations done for ununited fracture of the femoral neck. *A* Allie operation and *B* the Whitman operation. In both of these operations the head of the femur is removed. *C* Brackett's operation—the fractured head is replaced on its stump of the neck. Whitman's operation on an Allie Brackett's operation both require transplantation of the greater trochanter.



Fig 7 Reconstruction of the margin of the acetabulum. Ufulin's operation of the hip with resection of the acetabulum and the femoral head from the margin of the acetabulum and the leg is out with a long transplant (Dickson's operation).

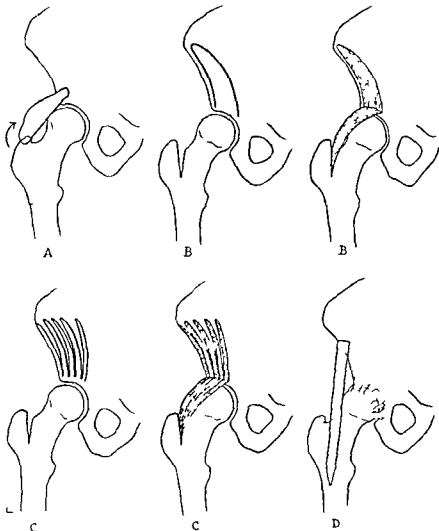
to the technique of operation. This is done by encasing the foot, leg and thigh in a sterile cover outside the rest of the sterile coverings so that the operator may grasp the leg and thigh and manipulate the hip without breaking asepsis.

We commonly use three methods of approach in arthrotomy of the hip. Taking them in order the steps of the anterior, lateral and posterior methods are as follows:

#### ANTERIOR APPROACH

There are several methods of anterior approach. The one used by us is perhaps better described as the superior anterior approach and is called by us the Smith-Petersen method. A similar method was used by Sprengel in Germany about 100 years ago and later by Anderson in England. Kocher describes this approach for removal of the ilium. We call the method the Smith-Petersen approach because of his rediscovery in 1917 of the value of this method of opening the hip joint.

Smith P I M Am J Orth 1917 5 97 59



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The patient lie on his side one third the way over with a long sand bag against his back.

1 A curved incision is made over the crest of the humerus from the anterior spine to a little beyond the middle of the crest.

A vertical incision is made on the anterior thigh from the anterior superior spine of the ilium to about 4 or 5 inches downward from the spine.

3 These two cuts make an angle with each other at the anterior superior spine. The skin and

subcutaneous tissue being divided the wound edges are covered with skin to be clipped secured by in place.

4 The upper arm of this anular incision should be completed first. Beginning at the anterior superior spine the incision is carried directly downward to the bone the origin of the gluteus medius being cut and the periosteum incised. With a sharp periosteal elevator the periosteum is now elevated from the ilium the muscles being carried

with it. The depth of the wound is packed with gauze strips.

5 The vertical arm of this angulated incision is completed by the intermuscular planes being entered between the sartorius anteriorly and the tensor fasciæ femoris posteriorly. The fascia is the only structure demanding division and by retraction the anterior surface of the hip joint capsule is clearly seen. The capsule should be divided in such a way as to preserve the iliofemoral  $\Delta$  ligament of Bigelow. After the freeing of the capsule from the cotyloid ligament at the acetabular margin a vertical cut is made along the border of the iliofemoral band of the  $\Delta$  ligament. This exposes the anterior external aspect of the head of the femur. By flexion of the thigh and external rotation the head of the femur is delivered. The exposure thus accomplished gives access to the acetabulum and the entire head and neck of the femur.

6 The flap is turned back after suture of the capsule, the gluteus medius is stitched to its perosteal attachment and the anterior line of suture is closed in layers.

#### LATERAL APPROACH

The lateral or Ollier's approach in which the hip from the region of the great trochanter is opened was recently advocated by J. B. Murphy<sup>1</sup> as a proper approach for arthroplasty of the hip. Lever also advised this manner of approach to the hip for arthroplasty. Baer has used it as the method of choice in his operations for reestablishment of motion at the hip. To us it seems less suited to arthroplasty than does the anterior approach because of the necessity for fracture at the region of the greater trochanter.

The patient lies on his side with the thigh flexed to 45 degrees.

1 A curved incision through skin and subcutaneous fat is made starting at the anterior superior spine and running to the posterior superior spine. The curve is flat U shaped with its lowest point about 1 inch below the tip of the greater trochanter. The flap is turned upward exposing the tip of the trochanter. The aponeurosis of the gluteus minimus is divided vertically and retracted backward.

The trochanter major is now cut through about 1 inch below its tip. The direction of this osteotomy is oblique so that the upper end of the cut is at the upper surface of the femoral neck. This detached fragment is pulled upward and carries with it the muscles which have insertion at the greater trochanter, i.e. the gluteus medius, gluteus minimus, pyriformis and gemelli.

1 Murphy J. B. Arthroplasty of the hip.

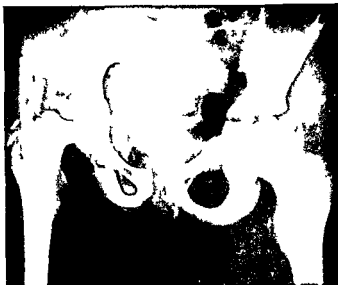


Fig. 8a. Roentgenogram showing bone transplant taken from the tibia and planted in the ilium and femur across the hip joint as described by the author.

3 The anterior margin of the gluteus medius is dissected from the posterior margin of the tensor fasciæ femoris. This exposes the upper surface of the joint capsule and the acetabular margin.

4 The capsule is divided vertically and the head of the femur dislocated by adduction and internal rotation of the thigh.

5 The fragment of the trochanter is sutured in place either by catgut stitches or a bone pin. The muscles are sutured together by interrupted sutures. The skin is sutured with silk, either an interrupted or continuous stitch being used.

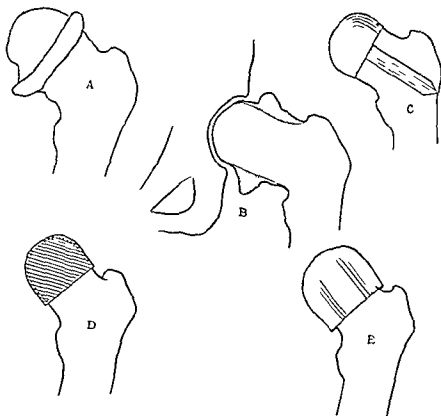
The lateral approach is admirably suited to removal of the head of the femur in old ununited fractures especially when some type of reconstruction is to be done as in the Whitman or Brackett operation. The reshaping of the neck and trochanter region is more easily accomplished. It is less damaging to the hip region than is the anterior approach; it requires less time for exposure and consequently is advisable as an approach in patients of advanced years or in those of poor physical condition.

#### POSTERIOR APPROACH

This method has been described by Ober and is called by us the Ober method. This approach is not desirable in conditions in which exposure of the head of the femur is required. Its use is for drainage of the hip joint or removal of tissue for examination and diagnosis. Ghormley has recently used it for replacement of slipping of the upper femoral epiphysis with good result. Langenbeck

Ob. & A. P. 1. Arthroplasty of the Hip. J. Am. M. Ass. 94: 1444, 5-5-1929.





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and Koller have described somewhat similar approaches.

1. The patient lies face down on the table. The buttock and upper thigh are prepared for incision.

2 In 1 it is made in a straight line running from the posterior lateral aspect of the femur obliquely upward and backward toward the sacro-coccygeal articulation directly over the neck of the femur and in the line of the fibers of the gluteus maximus.

3 The filers of the gluteus maximus are separated

4 The underlying fat is pushed aside by blunt dissection care being used to avoid the *cratichiae nerve* which is in the region of the medial extremity of the incision. The tendon of the obturator internus, the quadratus femoris and the gemelli and piriformi are now exposed and separated by blunt dissection and retracted to expose the posterior surface of the joint capsule.

5 The joint capsule is divided the whole length of the incision and drawn over removal of the valve is accomplished.

6. In order to maintain drainage the capsule may be sutured to the gluteal fascia or to areolar drains may be stitched to the capsular margins.

7 Closure is simple requiring approximation of the edges with catgut sutures. The skin is sutured with silk.

### POSTOPERATIVE CARE

After arthrotomy of the hip the ur-  
 always have in mind the danger of surgical shock.  
 The patient as a rule should be handled as though  
 surgical shock were present. A shock enema  
 warmed morphine in sufficient quantity and  
 force fluids are let employed in each instance.

Each different condition requires a particular type of after care. In general, when motion at the hip is the object of the operation, i.e. arthroplasty or drainage of infection, the hip should be put up

in overhead suspension so that the patient may move it as soon and as much as possible without pain.

In all procedures in which bony union is sought especially in fusion for tuberculosis or in fracture of the neck of the femur the hip should be fixed in a plaster-of Paris spica. It is often advisable to include the thigh of the opposite side in the plaster dressing in order to fix the hip.

Whenever arthroplasty of the hip is done and indeed for whatever purpose it is done it is nec

essary for the patient to be recumbent in bed for a considerable period of time. Consequently, good nursing care is essential both for the period of bed care and for the long period of re-adjustment when the patient is up with crutches seeking to re-establish function.

The prognosis depends entirely upon the condition for which the operation is performed. Each lesion carries with it certain unfavorable potentialities which result as a rule in more or less permanent impairment of the hip joint function.

## GASTRO-ENTEROSTOMY WITH A TRANSVERSE JEJUNAL INCISION

### PRELIMINARY CLINICAL REPORT

BY THEODORE S MOISI M D NEW HAVEN CONNECTICUT

F m th Dep tm t f ry Y f L ty hool f Med nd h S gical Cl f th New H H p tal N w H C

ALTHOUGH the success of any type of gastro-intestinal anastomosis is largely dependent on its mechanical efficiency, there are certain faults inherent in the motor mechanism of gastrojejunostomies performed according to the orthodox methods. These shortcomings are in large part due to the longitudinal jejunal incision which severs the circular muscle fibers and interferes with peristalsis throughout the length of the stoma. Thus insufficiency of the motor mechanism after the usual procedures suggested the probable superiority of a different type of anastomosis whereby a minimal amount of injury would be inflicted upon the circular muscle fibers of the intestine. This can be effected quite easily by the use of a transverse jejunal incision.

The mechanics of the orthodox side-to-side gastrojejunostomy have been the subject of an extensive experimental study by Cannon and Blake (1). These investigators repeatedly noted that food was forced through the patent pylorus to re enter the stomach via the proximal loop. This circulation of food was seen when the stomach was stretched by large amounts of food or water. They explained this phenomenon by the valve like action of the anastomosis. When the wall of the stomach is stretched so that the edges of the opening into the jejunum are separated the intestinal wall becomes flattened over the stoma and the openings into the intestine become merely narrow slits (Fig. 1). The opening on the proximal side of the stoma permits food which circulates via the pylorus and duodenum to return

into the stomach but both slits offer a valve like hindrance to the egress of food from the stomach via the stoma. The more the gastric

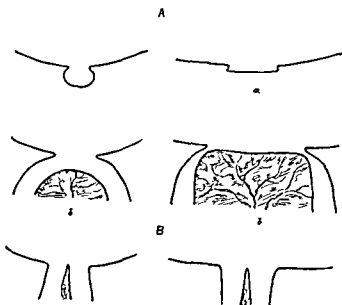
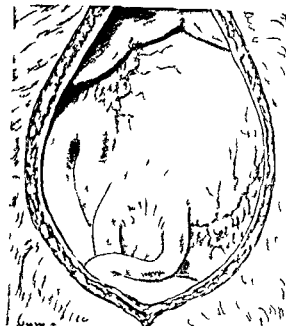
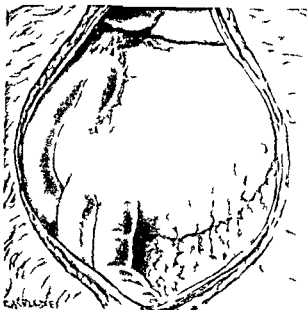


Fig. 1. A diagram showing the effect of extreme gastric dilatation on the stomach. A in the usual longitudinal section B in the entero tomo (longitudinal jejunal incision) C in the transverse section. The normal stomach is represented in the usual procedure in a and b in cross section and longitudinal section respectively and c represents a longitudinal section through the stomach after a gastro-enterostomy with a transverse jejunal incision. The dilated stomach is represented in a and b in the same manner as the normal stomach and c illustrates the dilatation produced in the stomach.



I g l h l k l l t t l m t l k t r  
 n t m v t h t n j u l l l l l  
 d t h l l t d k t m t t l t f  
 t l l m Th tra r j j l l u  
 m m l i n j y t t l l l l k  
 t h i l t t g f t t t t t f t l  
 t m.

l t l l l g l l t t x p m t l g t  
 t t m v p f m d l t t t h l t c h l  
 t l l t l l j j l t t p p e d l  
 f t l t l l g T l t m f t l m l l  
 h l t l t t l t m p t h l e u  
 h l t t g f t l j j l v l l t h a f d  
 f t l l m l l l On l l h t d  
 t t l t j f t l t t n t g r t d d  
 l t d l t h t t j j j j (F)  
 l l l l t m p r o l e u l t o j  
 j u l l t t t t l t l l g t t l j

wall is stretched the more effective the valves become. This phenomenon was also demonstrated in the excised stomach by distending it with water. Moreover the division of the circular muscle fibers at the stomach in the usual side to side gastrojejunostomy makes it impossible for peristalsis to be effective at the angulation in the jejunum at the distal end of the anastomosis and hence the force that normally pushes the food along and straightens the kink is lacking.

Various modifications have been suggested to avoid these defects in the side to side gastrojejunostomy. Kelling (3) thought that kinking was produced when the stoma was made too large so that when the stomach was stretched and the stoma further enlarged a spur of intestine might project into the gastric cavity. Case (2) suggested that kinking might be entirely prevented by attaching a few centimeters of jejunum beyond the distal end of the stoma to the stomach wall.

Moise and Harvey (6) described a method of gastro intestinal anastomosis after a partial gastrectomy wherein the jejunum is incised transversely rather than longitudinally and the end of the stomach is anastomosed to the end of the jejunum. The advantages of such a procedure over the usual end to side or side to side anastomoses are several. The procedure is an end to

end anastomosis and should have the mechanical and physiological advantages that are generally conceded for this type of operation. In contrast with usual method one avoids cutting the circular muscle fibers and accordingly there is no interference with peristalsis and no opportunity is afforded for the formation of an atonic dilated pouch opposite the stoma. After this end to end gastrojejunostomy the two jejunal loops naturally gravitate downward which is the optimum position for the maintenance of a patent stoma while this same tendency for the loops to drop down after the Polya anastomosis may tend to kink and partly occlude the lumen.

In a later communication Moise Hjaensen and Vogt (7) reported a comparative study between a series of gastrojejunostomies in do with the orthodox longitudinal jejunal incision and a similar series in which a transverse jejunal incision was utilized. The operative technique the size and placing of the stoma were identical in the two series. The functional results in the ten end to side anastomoses (transverse jejunal



Fig 4 The drawing illustrates an instance of a dilated stomach after the usual gastroenterostomy (longitudinal jejunal incision) with the valve formation described by Cannon and Blake. There is moderate angulation of the jejunal loop at the distal end of the anastomosis. The obstruction and concomitant stasis are due to this valve formation and angulation. This was observed in several instances (3 in 10) with the usual gastroenterostomy with longitudinal jejunal incision but in no instance with a transverse jejunal incision.

incision) were uniformly good. The roentgenographic studies showed that the stomach usually began to empty immediately after feeding. The emptying was never precipitous. The average emptying time for the series was  $5\frac{1}{4}$  hours, which is approximately the same as that of a normal dog under similar conditions. In animals without pyloric exclusion the emptying was via both the pylorus and the stomach.

Finally, examined *in situ* the anastomoses looked much as they did upon completion of the operation. The stomach was never dilated. The loops of jejunum hung directly downward in the ideal mechanical position (Fig 2).<sup>1</sup> There was no evidence of valve formation or kinking. Upon removal the specimens showed patent lumina about the size of a cross section of the normal jejunum.

In contrast there were three poor results in ten side to side anastomoses (longitudinal jejunal incision). In the 7 normally functioning anasto-

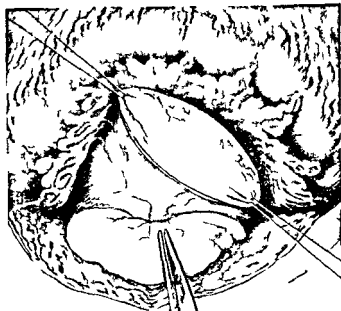
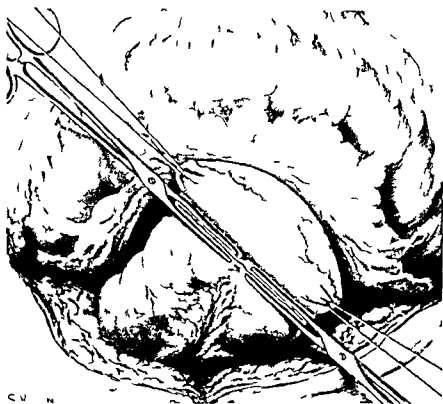


Fig 5 The opening in the transverse mesocolon has been made. The edges of the opening in the mesocolon have been sutured to the stomach wall. The two guide sutures indicate the line of the proposed gastric incision. The crushing clamp has been applied to the jejunum and an incision has been made across the intestine leaving a margin of one quarter of an inch at the mesenteric border.

moses the average emptying time was slightly longer than 5 hours (Fig 3). In the poorly functioning instances (3 in 10) there was definite evidence of gastric retention determined by roentgenographic study. In two animals the obstruction progressively became more and more marked and was associated with vomiting and emaciation. At approximately a month and a half after operation fluoroscopic examinations showed that the stomachs were greatly dilated and full of fluid. They did not empty perceptibly within 6 hours and after 3 days showed marked retention. At autopsy there was marked gastric distention (Fig 4). In each case the stomach was much enlarged and the opposite intestinal wall where the circular muscle fibers had been cut was markedly stretched and ballooned out in line with the stomach wall illustrating the valve formation described by Cannon and Blake.

The loops of jejunum gravitated downward from either extremity of the dilated stomach with moderate angulation of the gut at the distal end of the anastomosis. In the third animal a similar though less marked condition was observed. It seems highly probable that the animals took too much food or water thus producing distention with the concomitant valve formation and this condition once established gradually became more and more marked by the accumulation of normal secretions or by the further ingestion of food and water.



C. V. N.

I k ( H h g l m f h l n r t l l t l t f t l k l  
t l j j u m l l l m t l l t l t r f t t t l t m h  
l m l t l l l t l l n l t t l f l k t

It should be emphasized that there were no adhesions or permanent kinks and that the obstruction could be attributed to the valve formation only. The observations are in contrast to those of Cannon and Blake who did not believe that such valves were entirely responsible for their failures but state that the development of symptoms of the so-called vicious circle (vomiting, gastric retention, etc.) have been associated in their experiments with kinks and demonstrable obstacles to the free passage of chyme. They pointed out that under conditions with intact circular muscle fibers sharp angulations in the intestine may be readily straightened out by the force of peristalsis.

The purpose of the present communication is to present an operation, not entirely new in principle but which in comparison with the older method, develops more completely the efficiency of the transverse jejunal incision. This greater efficiency of the new operation has been demonstrated by clinical and experimental study and is ample justification for its introduction as a clinical procedure.

#### OPERATIVE TECHNIQUE FOR POSTERIOR GASTRO-JEJUNO-TOMY WITH TRANSVERSE JEJUNAL INCISION

The stomach, transverse colon, and omentum are turned upward to expose the under surface of the transverse mesocolon as in the usual procedure. The duodenojejunal junction is located. The posterior surface of the stomach is exposed by an opening made through an avascular portion of the transverse mesocolon. The stomach is delivered and the part required for the anastomosis is located. A guide suture is inserted at either end of the proposed incision into the stomach.

The line of the gastric incision may be selected as in the standard procedures. In the cases here with reported the opening was made so that the stomach would lie vertically or extend from above downward and to the right at an angle of 45 degrees with the horizontal. The exact line has been selected in each instance so that there was no rotation or kinking of the jejunum proximal to the anastomosis. The opening in the mesocolon is closed by the suturing of the cut edges to the stomach wall.



FIG. 5.

Fig. 5. The crushed edges of the jejunal opening have been excised after removal of the clamps. The continuous inner suture of catgut across the posterior half of the stomach has been completed.

The jejunum is lifted into position for a short loop operation. A point is selected between adjacent straight intestinal arteries and two small crushing clamps are applied side by side extending across two thirds to three fourths of the diameter of the intestine. A margin of  $\frac{1}{4}$  inch is left at the mesenteric border (Fig. 5). After an incision is made between the clamps their handles are separated and the direction of the original transverse incision is changed to run parallel to the long axis of the intestine. This portion of the jejunum is approximated to the stomach along the line of the proposed gastric incision so that the distal loop will lie near the greater curvature. A posterior row of interrupted silk sutures is inserted. Care is taken that the middle suture is accurately placed opposite the end of the original jejunal incision (Fig. 6). An incision is made into the stomach of the same length as the jejunal stoma (approximately  $2\frac{1}{2}$  inches). The bleeding is controlled with ligatures of fine plain catgut. The crushing clamps are removed and the crushed edges of the jejunum are excised. The anastomosis may be completed in accordance with the operator's preference.

The usual procedure in this series has been to commence in the middle of the anastomosis posteriorly with a No. 6 chromic catgut suture and carry it in either direction as a continuous through and through locked stitch (Fig. 7). This suture is continued around the angles as a continuous inverting mattress stitch until the anastomosis is completely closed (Fig. 8). Care is taken to invert a minimal amount on the jejunal side and thus avoid producing an unduly large diaphragm. The anterior layer is reinforced with interrupted mattress sutures of fine black silk to complete the anastomosis (Fig. 9). On completion of the anastomosis the stomach and transverse colon are replaced and the distal jejunal loop gravitates downward at right angles to the greater curvature in the optimum mechanical position (Fig. 10). The proximal and distal openings are each approximately the size of the cross section of the jejunum.

#### DISCUSSION

This communication is not concerned with a discussion of the indications for or the therapeutic value of gastrojejunostomy but is limited in its

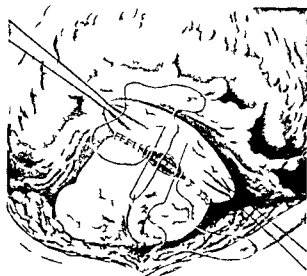


Fig. 1. The transverse jejunal incision.

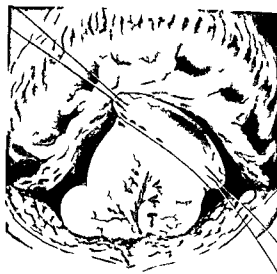


Fig. 2. The longitudinal jejunal incision.

sculpture and illustration of the technique, the mechanical advantages, and the results of the clinical application of a new method of making a gastroenterostomy with a transverse jejunal incision.

Although the utilization of the transverse jejunal incision in the performing of a gastroenterostomy is not entirely new, the older method is full of shortcomings. The developing possibilities of the transverse incision Mayo (5) in 1903 stated: "In June 1903 we began the method of Mikulicz, making the opening within three or four inches of the origin of the jejunum and using a transverse incision. We made forty-three by this method with four deaths, two of which could be fully excluded. Four required a second operation at our hands, and to a large extent because we departed from the originator's technique. It came all out this way: *The transverse intestinal incision limits the size of the opening to one half the diameter of the intestine*. It is about one-fourth inch suture line, and the opening could seldom be made larger than would admit the invaginated thumb. We tried to enlarge this by encroaching on the bowel and caused a valve to form which turned the bile into the stomach. These patients gave us a lot of trouble. The short upper limb of the loop made an ordinary enteroanastomosis of the two arms of the bowel impossible. We finally united the intestine each side of the opening in exactly the same manner as in the Finney operation at the pylorus. The result was good. This was our first experience with the short

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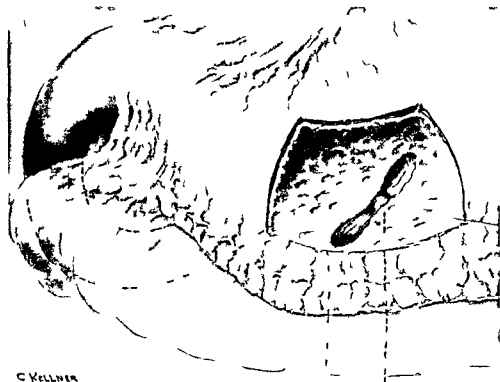
proximal loop, the cases which recovered after this method have remained in splendid condition despite the small opening.

I have been unable to find the reference to Mikulicz's procedure, but I assume that it is somewhat similar to the method of Kocher (4) which is illustrated in Figure 11.

According to the procedure mentioned by Mayo the size of the opening is limited to one-half the diameter of the jejunum according to Kocher's method the length of the incision is equal to the diameter of the intestine, but in the method described in the present paper the length of the opening obtained with the transverse jejunal incision is practically twice the diameter of the intestine (about 1 inch). The opening into each loop is approximately equal to the cross-section of the jejunum which obviously is the maximum possible size of the effective lumen in any type of anastomosis, even though a longer longitudinal incision into the intestine gives a seemingly larger opening.

#### CLINICAL APPLICATION

The operation of gastroenterostomy with a transverse jejunal incision according to the above technique has been performed in 23 instances including 17 in which the procedure was utilized as the operation of choice and 6 for palliative relief of pyloric obstruction in malignant disease. The 6 cases of malignancy on whom palliative procedures were performed are excluded from the following discussion of results. Among the former group of patients (Table I)



C. KELLNER

FIG. 10. The transverse colon and stomach have been replaced. The stomach (about 2 1/2 inches long) is shown through a window in the anterior wall of the stomach. The dotted lines (diagrammatic) illustrate the position of the proximal and distal loops.

are included 11 duodenal ulcers (one following an acid burn) 3 gastric ulcers (one of which also had a duodenal ulcer) 1 gastrojejunal ulcer and 2 carcinomata of the stomach. The operative procedures include 14 posterior gastro enterostomies one Billroth II one retrocolic Polya and one antecolic Balfour Polya. The results are given in Table I. The series is small but should represent a fair cross section of gastroduodenal lesions requiring surgical treatment.

At the present time only the immediate and early results can be adequately considered as the majority of the operations were performed quite recently and sufficient time has not elapsed for an evaluation of the remote results. However as the advantages in the new method are probably largely mechanical it seems unlikely that the remote results will differ from those observed following the usual procedures. The best indication of the mechanical efficiency of a gastrojejunal anastomosis is the frequency of the occurrence of postoperative vomiting and prolonged gastric retention.

The immediate convalescence has been surprisingly uneventful in the entire series. There was no postoperative vomiting whatever in 11 of the 17 cases; in 5 there was slight vomiting following the operation but complete relief was obtained after gastric lavage. In one case only

slight vomiting persisted off and on while the patient remained in the hospital.

The functional efficiency of the anastomosis has also been studied by routine fluoroscopic examinations of the stomach shortly before the patients were discharged from the hospital and at later intervals between 2 and 9 months after the operation. In a discussion of the immediate postoperative roentgenograms it is necessary to emphasize the fact that a moderate amount of gastric residue is very frequently observed after the orthodox posterior gastro enterostomy. This usually disappears after a few weeks and accordingly the occurrence of gastric stasis after 6 hours is not significant unless of extreme grade or unless it persists for a long period after operation. In the present series there was no 6 hour gastric residue in the immediate postoperative roentgenograms in 7 instances; in 8 there was slight retention and in 1 there was a marked gastric residue. There was no 6 hour residue in 13 patients on whom subsequent roentgenographic examinations were made at intervals between 2 and 9 months after operation. Of the remaining four patients one is free of all gastric symptoms (no X rays obtained) one is dead and two cannot be located.

Although the occurrence of symptoms of the so called vicious circle have been largely pre-



TABLE I—GASTROENTEROSTOMY WITH TRANSVERSAL JIJUNAL INCISION

DUI 1UI

C	A	I f y p	O	I f	I f	I f	I f
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C R	6 M		I I I I h I I h m f I d I I I db I by I	u- I os m I h j j I	Th I d I m I r I m I G I f I l I m I I f I N y 5 I m h I j 7 d y f f	9- 5 d m f p I f f m I p ms X N 6 h	
V K	M	m	C I I I g f I I b I l l	o- 6 I os m I h j j I	N d I m I Th I h m I I f I p d b I I h m I h l I f j I ph m I f f h I I f f 4 7	N 7 k f op N 6 h	
I	M		U I I os I I f	I my I h	N 6- V y m h g h f p e	t I I I p	
F B	M	m	P I I I f I I I h f I Adh f I d I m I f I	P os m I h I I	I h m I f h I I j I I I f I l I I d f I I h I	mo f F I m b d x od pot p un N y 9- 6- N 6 h	
T W	5 M		D I I I I h I I	7 I y I h	I h m I I mu d m I l h I m I h h o I I I I m I h I I h I d I f	7 I f p m d t I h b h h h I I I I d I d I I	
H L B	5 M		C h d I y I I I	I m I h I I	N I f f m h I m I f I I h j m I f	f m I m I f p e H I d I l b N 6 h	
P L	M	y	P f I d I I I I I I h I d I I d I f m d I	o- P my I h e I	V I I I m I l f m I mu I f I l I s I 6 h I h d j f I	I I f f I p m p d gh I I 6 h H I g d	
M M	5 M	y	D d I I h I p y I	6 7 P my I h j I	N I I h m h s s d y I m I m I I I	m I f d d p om I h I G d I l b	
M L	8 M		I d I I I os h I y I I C m f I I	8 7 P m I h I	N I I f f m m I m I 7 I h d m 6 h p	m f I p S C d I h I C d I l b s N 6 h	
M I	8	m	I d I m I h I d I I I I b I I	8 7 I m j I h I I	I h f m g I I I R I f h d som d 6 h f I 7 I d 7 d y f	f p I I I I d G h I co d	

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TABLE I—GASTRO ENTEROSTOMY WITH TRANSVERSE JEJUNAL INCISION (Continued)

(Gastric Ulcers (Continued))																									
C	A	D	t	O				P				R	l												
				I		d		Imm		d															
C	A	M	S	G	t	l	Post	t	g	P	l	g	t	g	l	Post	t	g	P	l	g	t	g	l	Post
C	A	M	S	G	t	l	Post	t	g	P	l	g	t	g	l	Post	t	g	P	l	g	t	g	l	Post
C	A	M	S	G	t	l	Post	t	g	P	l	g	t	g	l	Post	t	g	P	l	g	t	g	l	Post
C	A	M	S	G	t	l	Post	t	g	P	l	g	t	g	l	Post	t	g	P	l	g	t	g	l	Post
C	A	M	S	G	t	l	Post	t	g	P	l	g	t	g	l	Post	t	g	P	l	g	t	g	l	Post
C	A	M	S	G	t	l	Post	t	g	P	l	g	t	g	l	Post	t	g	P	l	g	t	g	l	Post
C	A	M	S	G	t	l	Post	t	g	P	l	g	t	g	l	Post	t	g	P	l	g	t	g	l	Post
C	A	M	S	G	t	l	Post	t	g	P	l	g	t	g	l	Post	t	g	P	l	g	t	g	l	Post
C	A	M	S	G	t	l	Post	t	g	P	l	g	t	g	l	Post	t	g	P	l	g	t	g	l	Post
C	A	M	S	G	t	l	Post	t	g	P	l	g	t	g	l	Post	t	g	P	l	g	t	g	l	Post
C	A	M	S	G	t	l	Post	t	g	P	l	g	t	g	l	Post	t	g	P	l	g	t	g	l	Post
C	A	M	S	G	t	l	Post	t	g	P	l	g	t	g	l	Post	t	g	P	l	g	t	g	l	Post
C	A	M	S	G	t	l	Post	t	g	P	l	g	t	g	l	Post	t	g	P	l	g	t	g	l	Post
C	A	M	S	G	t	l	Post	t	g	P	l	g	t	g	l	Post	t	g	P	l	g	t	g	l	Post
C	A	M	S	G	t	l	Post	t	g	P	l	g	t	g	l	Post	t	g	P	l	g	t	g	l	Post
C	A	M	S	G	t	l	Post	t	g	P	l	g	t	g	l	Post	t	g	P	l	g	t	g	l	Post
C	A	M	S	G	t	l	Post	t	g	P	l	g	t	g	l	Post	t	g	P	l	g	t	g	l	Post
C	A	M	S	G	t	l	Post	t	g	P	l	g	t	g	l	Post	t	g	P	l	g	t	g	l	Post
C	A	M	S	G	t	l	Post	t	g	P	l	g	t	g	l	Post	t	g	P	l	g	t	g	l	Post
C	A	M	S	G	t	l	Post	t	g	P	l	g	t	g	l	Post	t	g	P	l	g	t	g	l	Post
C	A	M	S	G	t	l	Post	t	g	P	l	g	t	g	l	Post	t	g	P	l	g	t	g	l	Post
C	A	M	S	G	t	l	Post	t	g	P	l	g	t	g	l	Post	t	g	P	l	g	t	g	l	Post
C	A	M	S	G	t	l	Post	t	g	P	l	g	t	g	l	Post	t	g	P	l	g	t	g	l	Post
C	A	M	S	G	t	l	Post	t	g	P	l	g	t	g	l	Post	t	g	P	l	g	t	g	l	Post
C	A	M	S	G	t	l	Post	t	g	P	l	g	t	g	l	Post	t	g	P	l	g	t	g	l	Post
C	A	M	S	G	t	l	Post	t	g	P	l	g	t	g	l	Post	t	g	P	l	g	t	g	l	Post
C	A	M	S	G	t	l	Post	t	g	P	l	g	t	g	l	Post	t	g	P	l	g	t	g	l	Post
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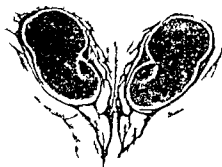


Fig. 1. Gross appearance of the right and left ovaries. The right ovary is shown in cross-section, revealing the internal structure, including the corpus luteum and follicles. The left ovary is also shown in cross-section, with similar internal features. The text below the illustration describes the gross appearance of the ovaries, noting the presence of the corpus luteum and follicles.

Fig. 2. Gross appearance of the right and left ovaries. The right ovary is shown in cross-section, revealing the internal structure, including the corpus luteum and follicles. The left ovary is also shown in cross-section, with similar internal features. The text below the illustration describes the gross appearance of the ovaries, noting the presence of the corpus luteum and follicles.

Fig. 3. Gross appearance of the right and left ovaries. The right ovary is shown in cross-section, revealing the internal structure, including the corpus luteum and follicles. The left ovary is also shown in cross-section, with similar internal features. The text below the illustration describes the gross appearance of the ovaries, noting the presence of the corpus luteum and follicles.

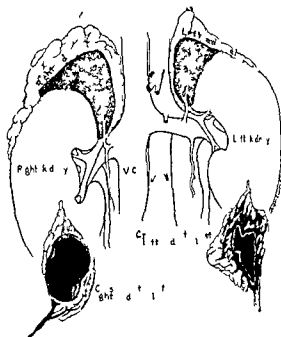


Fig. 4. Gross appearance of the right and left ovaries. The right ovary is shown in cross-section, revealing the internal structure, including the corpus luteum and follicles. The left ovary is also shown in cross-section, with similar internal features. The text below the illustration describes the gross appearance of the ovaries, noting the presence of the corpus luteum and follicles.

Fig. 5. Gross appearance of the right and left ovaries. The right ovary is shown in cross-section, revealing the internal structure, including the corpus luteum and follicles. The left ovary is also shown in cross-section, with similar internal features. The text below the illustration describes the gross appearance of the ovaries, noting the presence of the corpus luteum and follicles.

into the fat subjacent to it. The clot in this organ is partly broken down. The left adrenal presents the same picture of hæmorrhage. Here the mass is contained practically entirely within the organ. In only the upper pole has it broken into the surrounding tissue. Here the clot is firm to the touch. Definite thrombosis of the central vein is not made out grossly.

**Microscopic examination.** Microscopic examination made of sections from the various viscera are all essentially negative except for sections of the kidney and adrenals. Microscopic examination of sections of the kidneys shows in the fibrous capsule several rather sizable accumulations of lymphocytes and slight hæmorrhage. In the superficial layer of the cortex just beneath the capsule and in several points of the medulla there are discrete focal accumulations of lymphocytes. A number of sections were taken from each adrenal (Fig. 3) and sections from each tissue shows the hæmorrhage in the medullary portion of the adrenals extending to various degrees into the peripheral fat. In addition a number of large veins show thrombotic occlusion. There is no evidence of any new growth associated with the process. There is also no evidence in the histology that any infectious process was present. Further it should be noted that microscopic as well as the gross findings fail to give indication as to the etiology of the process.

One wonders in retrospect whether the vague abdominal symptoms of 6 years ago were associated with transient disturbances of the suprarenal gland, possibly a small hæmorrhage which was finally absorbed. It is apparent according to the symptoms that in the attack which caused his death the right gland was involved first and the left gland followed some days later.

This type of profuse hæmorrhage into both suprarenal glands must be differentiated from the small diffuse ecchymoses and hæmorrhagic spots of toxic origin occurring during acute infectious diseases. Small toxic ecchymoses are frequent; massive hæmorrhages are rare in children and extremely rare in adults.

In 1906 Lavenson published an exhaustive yet concise review of the entire subject of acute adrenal insufficiency up to that time. Since then there have been few publications of note in English but among the Germans the works of Lissauer (1908), Materna (1910), Kempf (1918), Freudemann (1920), Fraenkel (1923) and Brasser (1924) must be mentioned as worthy contributions. Since 1906 20 cases of bilateral suprarenal apoplexy in adults have been reported by Munson, Læderick, Garipuy and Schreiber, Lissauer, Hektoen, Brodnitz, Ellis, Valentin, Weidman, Foster, Freudemann, Michaux and Marsset, Fraenkel, Brasser, Kessel, Bittorf and Severn.

When we search for etiological factors we are struck by the great number of theories advanced which indicates in a way the unsatisfactory state of our knowledge. In tracing the various factors one is tempted to turn to the period at which the condition is more frequent, namely in the newborn and in childhood. Kempf calls attention to the embryology of these sensitive glands

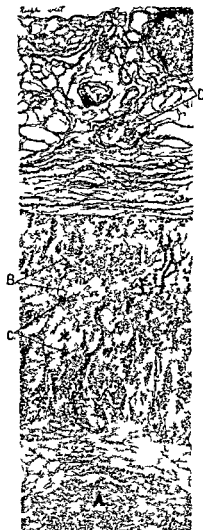


Fig. 3 Microscopic section of affected adrenal. The medullary portion *D* is occupied by a large blood clot which has destroyed all evidence of medullary tissue. In the cortex one sees marked hæmorrhagic infiltration *B* with destruction of most of the cortical cellular elements with the exception of a few scattered cell columns *C*. In the peri-adrenal fat one sees thrombosis of the vessels in early stages of organization *A*. Low power.

as a predisposing factor in the young. The fusion of the interrenal (cortical) and the adrenal (medullary) anlagen into a single organ takes place very gradually and reaches its full development between the end of the first year and the cessation of growth. In intra uterine life what is to be the suprarenal gland consists only of interrenal tissue in which only a few sympathetic elements are included. The newborn adrenal shows an outer layer consisting entirely of cortex and an inner layer broader and darker filled with lymph consisting mostly of cortex except for small plexuses of medullary cells dispersed among the veins. In the first month there occurs a capillary hyperæmia of the inner layer associated therewith a beginning degeneration of

cortical cells. From the second month to the twelfth month the hyperæmia is marked and there occurs further fatty vacuolar and colloid degenerative changes in the cortical cells the place of the atrophic cells being taken by the medullary cells which ever increase in number as if being able to withstand the pressure of the hyperæmia to which the cortical cells succumb. This process persists to the cessation of growth and evidence of it is even found in adult suprarenals. It is this hyperæmia and destruction which Kempf claims is the most important predisposing factor in adrenal hæmorrhage in the young and may also play a part in adults.

The trauma and circulatory disturbances incident to labor have often been suggested as causes in the newborn yet suprarenal hæmorrhage is known to occur in cases in which the delivery has been exceptionally quick and easy and there are a great number of extremely difficult labors in which these glands have remained intact. Some have also suggested the resuscitation methods of Schultz to be responsible but this has been disproved.

In adults many conditions have been advanced as having an etiological bearing. Among these are thrombosis, capillary emboli, congestive diseases, infectious and toxic diseases of the solar plexus, surface burns and hæmorrhagic diathesis. Simmonds reported 7 cases occurring during the course of chronic diseases in the viscera in all of which the suprarenal veins were found to be thrombosed.

Lavenson reports the finding of only two cases of acute adrenal insufficiency in which hæmorrhage or necrosis were not responsible, one case in which there were abscesses of both suprarenals and the other in which there was suppuration of both suprarenals in a case of Pott's disease. He reports a case in which thrombosis was evidently the causal factor and suggests that regional suppuration may in some cases cause thrombosis of the suprarenal veins. Thrombosis of the small vessels was also noted by us in our own case but the large vein was free. With Simmonds, Lavenson, Brasser, Kempf and others we agree that thrombosis is the most important etiological factor in the production of hæmorrhage and necrosis of both adult suprarenal glands. In some cases thrombosis may produce a marked infarction in others only a lesser degree of hæmorrhagic infiltration. Simmonds claims that this depends upon the occasional presence of a row of accessory suprarenal veins which empty into the diaphragmatic veins and are variable in size and number.

Simmonds noted in the cases reported by him that the thrombi in the central veins and larger branches were definitely older than those in the small branches and capillaries and concluded therefore that thrombosis was necessarily the primary causal factor in these cases the hæmorrhage being secondary. Were hæmorrhage the primary phenomenon the older thrombi would occupy the smaller vessels the larger branches and central vein would be the seat of fresh thrombi or be entirely free of them. Lissauer and Ellis in reporting similar cases accept these views.

Some writers have suggested a relation between the production of hæmorrhage and the somewhat unusual vascular anatomy of the suprarenal glands. Lavenson and others direct our attention to the fact that the arterial supply coming as it does from three sources is unusually great and that the blood after traversing the medulla leaves at the hilus by a single large thin vein which empties on the right into the vena cava and on the left into the renal vein. He and others have also noted that the medulla is much more frequently and profoundly affected and that the right suprarenal is much more often the seat of hæmorrhage than the left. Lavenson suggests that simple alterations of blood supply or blood pressure may therefore be determining factors in the production of hæmorrhage especially in the newborn. Kempf and Brasser even as late as 1914 in noting the peculiarities of the vascular anatomy suggest that the slowing of the blood current may predispose to thrombus formation in which Brasser thinks infection may play a part.

That any consideration of a purely anatomical nature may have an etiological relationship is unlikely in a condition of such extreme rarity yet considering that hæmorrhage has already taken place the anatomical peculiarities may determine the overwhelming participation of the medulla over the cortex and the right side over the left both as to incidence and extent of involvement.

Arnaud, Churton and Dudgeon have reported cases in which suprarenal apoplexy was associated with severe surface burns and some have suggested an etiological relationship between the two conditions. Simmonds feels that some of these cases were the result of an hæmorrhagic diathesis. Virchow claims that diseases of the solar plexus are responsible. In those cases which are associated with convulsions Lavenson suggests that the convulsions may have produced the hæmorrhage rather than the hæmorrhage the convulsion. Brasser and others suppose that there

may be a constitutional defect in the blood vessels which predisposes to thrombosis

Dudgeon has arbitrarily divided cases of suprarenal hæmorrhage into three groups depending upon the degree of involvement. In the first group the whole glands are converted into blood sacs with occasional extravasations into the surrounding tissue, our own case fell into this group. In the second group there is a well marked hæmorrhage into the medulla, the cortex being spared except for a few erythrocytes scattered between the columns of adrenal cells. These two groups are often associated with thrombosis of the suprarenal veins and when both glands are affected are usually fatal. In the third group there is scattered hæmorrhage into the gland substance chiefly in the medulla with little or no destruction of parenchymatous elements. This last type is most frequently noted in the acute infectious diseases is not usually the cause of death and is not included by us in the class of suprarenal apoplexies.

That the hæmorrhage beings in the medulla is noted by many writers. The cortex is secondarily involved possibly by compression. The relation between these facts and the vascular anatomy has been previously noted.

It is interesting to note that suprarenal blood tumors of enormous sizes have been reported. These however are unilateral findings; the other gland usually being intact. Roger reported a case in which there was a blood cyst of 1 kilo-grams produced by hæmorrhage into a suprarenal gland. Carrington found suprarenal blood cysts the size of oranges. Routier described the case of a man of 32 years who complained of epigastric pain and vomiting of 3 years' duration in which a 1600 gram suprarenal cyst containing changed blood was found. Pawlock notes a suprarenal cyst of 10 liters. Chiari a 3 pound cyst. Such large tumors however are not found in cases of bilateral suprarenal apoplexy.

Arnaud recognized three arbitrary clinical groups. The first is the so-called *peritoneal type* in which there is usually sudden severe abdominal pain and profound collapse associated with vomiting, moderate abdominal distention and mild lumbar and epigastric tenderness. The picture may resemble acute hæmorrhagic pancreatitis, peritonitis or ileus, yet the physical signs are vague and the shock is out of all proportion to them. The collapse usually goes on to coma and the patient dies in a few days in profound depression. Such a picture has led to surgical interference as was deemed the procedure of choice in the case of Brodnitz who found

nothing but three portions of contracted and anemic small intestines each 10 to 20 centimeters long. At the autopsy the essential pathology was located in both suprarenal glands. Brasser, Materna and others consider the abdominal symptoms to be due to the abnormal epinephrine content of the blood and to vary according to whether it is increased or diminished. Pende thinks that they are due to disturbances of the solar plexus.

In the second type called the *asthenic type* asthenia is the only symptom of note progressing to a fatal termination.

In the third type the *nervous symptoms* dominate the clinical picture. There may be delirium, coma, convulsions or a typhoid like state.

To these types Lvenson has added a fourth which includes cases of sudden death in which nothing is found postmortem but suprarenal destruction and a fifth comprising those cases which are associated with purpura of the viscera and skin. Virchow suggests that the initial sudden increase in blood pressure may tear a vessel previously damaged by bacteria or toxins and thus produce the so called purpuric spots; he suggests too that any sudden disturbance of the medulla oblongata may be a primary cause. Foster considers the purpuric spots as another manifestation of an overwhelming infection.

Any combination of symptoms may form the clinical picture but asthenia is the most constant and characteristic of all symptoms.

Materna (1912) claims that the symptoms of suprarenal hæmorrhage are caused by auto-intoxication with adrenalin which during the profound disturbance is thrown into the blood stream in large amounts. Hyperadrenalemia was found postmortem in one of his cases by the use of certain tests. In one test a specimen of blood collected from that flowing spontaneously from the liver produced prompt mydriasis on the living and on the isolated eye of the frog. In another the presence of adrenalin in large amounts was demonstrated by the action of  $\frac{1}{2}$  per cent ferric chloride solution on frozen liver sections and on blood serum in these the liver cells and the serum took on a green tint characteristic of adrenalin. These findings were checked with test solutions of 1:1000 adrenalin chloride and by chemical analysis. He suggests that when hæmorrhage occurs in a suprarenal gland rich in cholin this product the antagonist of adrenalin may also be thrown into the blood stream and neutralize in whole or in part the effects of the adrenalin. Thrombi in the large

work but the operator of vast and varied experience in dealing with pathological abdominal ridges should be chosen. Only the latter can best deal with any of the many complications that may be present with this proviso I am able to stand back of what I have said. I purposely speak in this manner as I want to give you something to take home with you. In the old days when discussing the subject we fought like bulls in the arena but behind the scenes we were peaceful lambs. I hope it will also be so today.

I have used the words forbidding peritonitis. This will be discussed later.

In the presence of a circumscribed peritonitis removal of the appendix with the proper technique is the correct thing to do. By the proper technique I mean that the incision should be made lateral to the point or line of greatest tenderness which indicates the position of the appendix. We should not hesitate to cut the internal oblique and transversalis muscles in a direction opposite to the course of their fibers if this gives easier and better exposure. To operate with the view of preventing a subsequent hernia is to expose the patient to the greater and more serious risk of dissemination of infection. If the appendix lies close to the cæcum directed upward and outward an extraperitoneal approach is the safest route and is easily made when after the overlying muscles have been cut through the transversalis fascia which is often oedematous and infiltrated can readily be separated from the peritoneum and the latter exposed. At this point palpation will often detect fluid and by hypodermic aspiration the character of the fluid can be definitely determined. The peritoneum is opened in the line of the wound the fluid often actual pus or puruloid material evacuated and the cæcum and appendix exposed.

If the appendix is not in sight I at once lift up the overlying abdominal walls with Deaver retractors and thoroughly pack off the surrounding peritoneal cavity with moist gauze pads. If pus is found it is mopped up during the dissection in freeing the appendix. With a piece of moist gauze the cæcum is grasped with the fingers and thumb and gently lifted into the wound which must be large enough to allow carrying the cæcum far enough out of the wound to expose the anterior longitudinal muscular band the ileocolic fold of peritoneum the terminal ileum and the ileocecal fold of peritoneum which is continuous with the meso appendix. The base of the appendix is then seen on the outer side of the ileocecal fold. These peritoneal folds are to the operator what the light houses are to the mariner. In the course of the dissection small moist pieces of gauze are so placed as

to prevent contamination of the exposed peritoneal spaces. These small pieces of gauze with the previously placed large pieces enable one to guard against contaminating the non infected surrounding peritoneum. The appendix being delivered it is tied off and removed with the cautery knife a glass drainage tube is carried into the pelvis and aspirated to determine whether there is pus in the pelvis. If the smear of this aspirated fluid shows micro organisms the tube is left in if not it is removed. A cigarette drain or a rubber tube may later be substituted for the glass tube if drainage is necessary. When the case has been a very dirty one no attempt is made to close the wound.

In the presence of pus I always examine the external paracolic groove. Occasionally it will also be found to contain pus and if so I explore farther upward and often find a collection between the diaphragm and the liver as well as beneath the liver. These respective points are then thoroughly drained. I have operated upon many such cases with excellent results. The latter type of case represents a combined circumscribed and limited diffused peritonitis. In my earlier experience under the conditions I have just mentioned I terminated the operation by simply evacuating the collection at the site of the appendix removing the appendix and instituting drainage. When practicing this technique I was frequently obliged to operate later for one or more secondary collections so that I have adopted the technique just described.

If you were to ask me to what I attribute what ever success I have in the surgery of intra abdominal pus collections I would answer first to the location of the collection or collections of pus and second to the proper disposition of gauze pads not gauze towels before I attack the collection. This question was once asked me by that great and master surgeon the late John B. Murphy when I gave him this answer. Murphy said Amen. I grant you this requires skill and art both of which can be acquired by experience. When as some of you have heard me I ask my gauze nurse why she is so confident in telling me that so many pieces of gauze are missing she answers My experience in this job gives me confidence.

A circumscribed peritonitis is easily recognized by the presence of a limited swelling limited rigidity limited tenderness circumscribed pain and either the absence of peristalsis or hypoperistalsis as compared with the peristalsis surrounding the peritonitic area. Either with resonance to light but dullness and flatness to deep percussion and limited movement of the abdominal walls over the site of the lesion. In making the diagnosis I

attach the greatest importance to the physical signs. A leucocytic and polynuclear count should be made as a routine measure but in the majority of instances I attach little importance to either. When I do consider the blood picture I pay more attention to the polynuclear than to the leucocytic count.

In circumscribed appendiceal peritonitis with the abscess close to the ileocecal junction beneath the terminal ileum and mesentery and with the terminal ileum thickened and stiffened having to a great degree if not entirely lost its contractile power after the pus is evacuated appendix removed and drainage established an ileocolostomy or sometimes an ileocecostomy will make recovery more certain. I have done this many times with most satisfactory results.

This is particularly true in the large abscess cases in which this portion of the bowel forms part of the wall of the abscess cavity for then not only the patient's recovery is better assured but also his immediate postoperative comfort for there is less likely to be pain from the retention of gas. Again secondary operation for obstruction that occurs occasionally in these cases three or four or more days after operation is avoided.

Let us now consider diffusing peritonitis by which is meant a spreading inflammation not involving an extensive area and differing from the circumscribed variety in that it is not limited. In the diffusing peritonitis there is both peritoneal inflammation and peritoneal irritation the latter being the forerunner of the former. You may regard this as a distinction without a difference but I hope to show you that it is not. Diffusing peritonitis differs from the circumscribed variety in that while the patient looks and is sicker yet he has not the peritoneal facies. The pain is more pronounced and is referred over a greater surface there is a much larger area of rigidity and tenderness peristaltic sounds are either absent or very feeble or peristalsis is aggravated around the inflamed area corresponding to the area of peritoneal irritation and abdominal breathing is more limited than in circumscribed peritonitis. Diffusing peritonitis is definitely recognizable by the careful observation of these physical signs. Time and again have I demonstrated this to my classes and subsequently proved it at operation by the presence of inflammatory adhesions adherent coils of bowel and adherent omentum occupying the area mapped out as the site of the inflammation when examining the case before the peritonitis had subsided. Cases of diffusing or spreading appendiceal peritonitis are not operated upon until the subsidence in part or in whole of the

peritoneal inflammation which in the experience of the Lankenau Clinic practically always takes place if strict anatomical and physiological rest regulation as we call it is carried out. I regret to say that outside of our clinic when I see this treatment it is not always given correctly. The familiar saying what is worth doing at all is worth doing well certainly applies here therefore even at the risk of trying the patience of those of you who are as familiar with it as I am I shall describe this treatment in detail.

First allow me to say as you know this is better known as the Fowler Murphy Ochsner treatment (a galaxy of stars of master surgeons whose memory and great achievements have been left to us as a priceless heritage). In the Lankenau Clinic for brevity of expression we style it regulation but not in any sense in the attempt not to use the names of the originators for they are names to conjure with.

Anatomical and physiological rest means rest of the body and of the alimentary canal. Rest of the body consists in confining the patient to bed in a sitting position which is maintained by means of a pillow placed beneath the tubersciui and a folded sheet carried beneath the portion of the pillow anterior to the tubersciui the ends of the sheet being carried to the head of the bed to which they are tied the patient's back being supported by pillows and a pillow placed beneath the knees.

To keep the patient in this position calls for much attention upon the part of the nurses. The position can be made easy to a great extent by the mechanical beds used in many hospitals but they are not used in our clinic. Rest of the body is further aided by giving small doses of morphia which serves a double purpose in that it also rests the small intestine by reducing peristalsis. Rest of the alimentary canal physiological rest is obtained by washing out the stomach giving nothing by mouth either in the way of water or nourishment by giving enough morphia hypodermically to prevent active peristalsis applying ice to the abdomen to numb the nerves of the walls of the abdomen this in turn affecting the abdominal sympathetic nerves with which the nerves of the abdominal walls communicate through the spinal ganglia and lastly giving the Murphy drip of normal saline solution to which is added glucose and whisky. It is not uncommon to be told by nurses that the patient will not take the intra-rectal solution but this happens only when it is not being properly given. This was stressed by Murphy when he first described the method stating that the height of the container of the solution above the level of the mattress must be



such that the intra abdominal pressure and the pressure of the solution entering the rectum are equally balanced. For example if the pressure of the saline solution is too great as happens when the container is placed too high the solution will not be retained while if the reverse is the case no fluid enters the bowel. This calls for intelligence and knowledge on the part of the attendants. This treatment must be consistently carried out until the conflagration the peritonitis is under control as evidenced by restoration of normal peristalsis which has been held in abeyance to prevent dissemination of infection and which can be recognized by abdominal auscultation and the passing of flatus a sound so harmonious to the ear of the doctor and the nurse. This indicates that the crest of the wave has been reached and the storm will soon abate. It further means that the peritonitis will either entirely clear up or become circumscribed when operation can be done with a greater degree of safety than when the storm is raging. Richardson expressed the idea so well when he said "too late for an early and too early for a late operation."

The rationale of this treatment is worth while detailing. Washing out the stomach quiets the movements of the diaphragm the under surface of which is so rich in lymphatics and lymph spaces and this quiescence affords the patient immediate relief. The diaphragm when in active motion performs the function of a suction pump in that infection is rapidly drawn into the lymph spaces and the lymphatics through which it is carried in to the blood stream causing blood stream infection. This is sufficient reason not to give medicines or anything by mouth that might excite nausea or vomiting. In the presence of the latter lavage should be repeated. It is a well known physiological fact that water given by mouth is absorbed by the terminal ileum and the first portion of the ascending colon and to reach the latter it must be carried by peristalsis of the small bowel which in turn means danger of spreading the infection. This means we drink with our terminal ileum and the first portion of the colon. On the other hand if the intestines are parietic the plexuses of Meissner and Auerbach under the control of toxins fluid given by mouth will cause waterlogging overdistention and reverse peristalsis regurgitation of duodenal and stomach contents and vomiting a further indication for lavage or the passage and retention of a duodenal bucket in the stomach to maintain continuous drainage.

The second physiological fact is that absorption of nourishment takes place in the small

intestine therefore we eat with our small intestines. Sir Berkeley Moynihan's lines

P t t on p lls pu get on in an app d r k k d  
nd b d Food and d nk rry h m d aper ts  
t m h m mad

exemplifies the rationale of arresting peristalsis by not giving anything by mouth. I am sure many or some of us at any rate recall reading that wonderful little book long since out of print by the distinguished Englishman Hilton on rest and pain which supports the rationale of putting the intestines at rest and abolishing pain by giving morphia. However I do not think it necessary to go so far as did Alonzo Clark or does our distinguished colleague and friend Crile who gives enough morphia to reduce the respirations materially. As I see it the therapeutic indication is carried out when we abolish peristalsis and pain and maintain rest of the body. The fact that nature does this in the late stage of peritonitis toxicemic abeyance of peristalsis sustains the rationale of physiological rest.

This I believe is sufficient to impress upon you why I advocate the treatment of anatomical and physiological rest or regulation as we prefer to call it. It is not at all uncommon when I am called at night by phone to be told that a case of appendiceal peritonitis sick for 3 or 4 days has been admitted to my hospital service for Mrs. Deaver to say "Tell them to put him on regulation." This may suggest how familiar this treatment is in some home circles. I do not hesitate to say that any form of treatment other than this is unanatomical unphysiological and entirely out of tune with nature's forces therefore not only irrational but illogical. I am prepared to say that this treatment cannot be thoroughly carried out in the home but only at the hospital and often here it is not successful for want of absolute faith begotten by large experience with it and the want of knowledge how to use it. Faith here as in religion we must have to award our peritonitis patients and to award ourselves. Before leaving this subject I might say that in addition to this treatment hypodermoclysis and intravenous saline with glucose are used in the very dehydrated cases. I have not had much success with continuous intrasaline as practiced by Matas partly due no doubt to the extreme condition of the patient when the treatment was instituted. Does this not often happen with extreme measures used when too late to expect good results?

Finally let us discuss diffused appendiceal peritonitis. Diffused appendiceal peritonitis in its early stage presents a picture familiar to us all with its general rigidity of the anterior abdominal

wall tenderness corresponding to the area of rigidity practical absence of abdominal breathing the peritoneal facies rapid pulse tense and often bounding comparatively high temperature and exaggerated peristalsis The blood picture shows eighteen to twenty thousand leucocytes and eighty five to ninety five polynuclears the latter varying with the type of the infection Twenty to forty hours after onset of the peritoneal inflammation or earlier if the patient has been purged the picture changes to one of general abdominal distention the rigidity being much less pronounced tenderness not nearly so decided entire absence of peristalsis later followed by tinkling and finally a silent belly an ominous sign when only the pulsation of the abdominal aorta is heard louder than normal and a rapid pulse with diminished volume more pronounced peritoneal facies a blood picture of moderate or low leucocytosis but high polynuclear count diminished output of urine that shows albumin hyaline and granular casts relaxed skin that later is sweaty and cyanotic vomiting or

regurgitation of dark vomitus often foul smelling and restlessness and an active brain This presents what is considered a hopeless proposition but not necessarily so if the treatment already described is carried out early and to the letter I have seen recovery with local abscess formation, the simple evacuation of which was followed by convalescence When much of the active peritoneal inflammation has subsided but has left multiple foci of pus the patient dies of toxæmia When the peritoneal inflammation has only partially subsided and has left a large collection involving the pelvis and the lower abdomen the patient may sometimes by drainage alone get well These are cases in which puncture through the rectum or the vaginal vault have occasionally proved successful

I have however seen instances of the latter type in which death occurred a few hours after a simple puncture In this class of cases shortly following the puncture there is a sudden marked rise of temperature always a precursor of death

## THE CLINICAL SIGNIFICANCE OF CHOKED DISCS PRODUCED BY ABSCESS OF THE BRAIN<sup>1</sup>

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THE ocular syndromes produced by brain abscess and brain tumors are similar but in the former the ophthalmoscopic evidence that the associated choking of discs has reached a definite stationary height or is still developing is of great importance from a neurosurgical standpoint

The formation of a brain abscess was well described by Macewen in 1893 and since that time little has been added to his classic work. He divides the clinical sequence of events produced by the formation of a brain abscess into the initiatory stage characterized by severe head pains vomiting rigor and fever the second stage characterized by deadening of the head pain which can be elicited only on percussion slow cerebration want of sustained attention apyrexia slow pulse paralysis and optic neuritis and the terminal stage in which there is either leakage of the pus into the membranes or ventricles accompanied by fever convulsions and coma or complete encapsulation of the abscess which may remain quiescent for a long period

and finally may become absorbed in some cases without surgical interference

In Macewen's cases optic neuritis was frequently seen especially in the later stages and was usually mild although in some cases the swelling of the optic discs advanced rapidly and even increased after the abscess had been evacuated. The term optic neuritis which was used up to 1893 and even later in describing the œdema of the optic discs produced by brain abscess or tumor has been replaced by the term choked discs inasmuch as the œdema is due to increased intracranial pressure and is not the result of inflammation. In cases of choked discs there is no loss in visual acuity or changes in the perimetric fields characteristic of optic neuritis.

The cases observed in the Mayo Clinic in which brain abscess has been associated with choked discs were in the second and third stages (Macewen). In the other cases of brain abscess there has been a fulminating course with early death without the appearance of choked discs. Clinically the ocular syndromes produced by encapsu-

lated brain abscess are the same as those produced by tumor of the brain. In 11 cases of definitely encapsulated abscess of the frontal lobe the bilateral choked discs in 8 ranged from 1 to 6 diopters. The visual acuity was good in all cases and the perimetric fields revealed only mild concentric contraction for form and color. Only one abscess of the frontal lobe which produced a typical basal frontal syndrome could be located ophthalmologically. This does not agree with Eagleton's experience in cases of abscess of the frontal lobe. In cases of temporal and temporo-sphenoidal abscess there was the typical ophthalmological syndrome produced by tumor in that region: normal visual acuity, bilateral choked discs and homonymous hemianopic defects of the visual field. This same syndrome was revealed in cases of abscess of the occipital lobe. The choked discs also varied from 1 to 6 diopters in these groups. In cases of abscess of the cerebellar lobe a choked disc of more than 2 diopters was not observed, which is quite the opposite to observations made in cases of cerebellar tumor. In all of the groups the pupillary disturbances, oculomotor paralyses and nystagmus were of no clinical importance in determining the site of the abscess.

Repeated ophthalmoscopic observations of the choked discs is of great importance in cases in which the diagnosis of brain abscess is definitely established as the ophthalmologist can be of aid in determining, more or less accurately, the time at which the abscess is completely encapsulated. In the Mayo Clinic it has been noted that the best results are obtained by operation in those cases in which the neurological and ophthalmological syndromes could not be distinguished from those produced by a brain tumor similarly situated. In such cases the history and the pathological changes in adjacent structures established the diagnosis of abscess. In every case there was choking of the discs which had reached its maximal height and was stationary. The encapsulated abscess then acted purely as a foreign body or tumor to which the cerebral tissues had become adjusted. When operation was performed during the period when choking of the discs was increasing the postoperative

course was stormy and the mortality rate rather high. As a rule the choking of the discs reaches the maximal height in a relatively short time so that surgical interference is not delayed and the ultimate prognosis is much better. Choked discs are not present in all cases of encapsulated abscess just as they are not found in all cases of brain tumor and their absence should not be misleading. The presence of choked discs especially in association with mastoiditis and questionable intradural involvement does not prove the existence of brain abscess and hasty intracranial operation is to be discouraged in those cases.

#### CONCLUSIONS

1. The ocular syndromes produced by an encapsulated brain abscess are the same as those produced by a brain tumor similarly situated.

Choked discs in cases of cerebellar abscess have less elevation than those produced by cerebellar tumors.

3. The presence of choked discs in cases of intradural suppuration does not always signify the presence of brain abscess.

4. Rapidly developing choked discs in cases of brain abscess are significant of a changing cerebral process. Intracranial operations during this period give unsatisfactory results.

5. Stationary choked discs in cases of brain abscess observed over a short period of time indicate encapsulation. Intracranial operations during this period give excellent results.

6. Repeated ophthalmoscopic examination of choked discs in cases of brain abscess is of great prognostic value.

#### BIBLIOGRAPHY

- E GLETON W P B t ab c s t s u I p th l gy  
I p xt tech que New Y k Th M t  
m lla C mpa y 92 p 3  
2 LILL H I d L t r W I Ch k d d c n so  
nat W th g al m st d d ew th t appa  
t t ad l n ol em t A h Ot l r j l  
9 5 355 36  
3 LILL W I O l e p h e m a p d c d by ba t  
fr t l l be l n Tr S t Ophth Am J A s  
9 67 10  
4 M CEY T W Lias Py e f ct d f  
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## THE HORSLEY PYLOROPLASTY IN ACUTE PERFORATED DUODENAL ULCERS<sup>1</sup>

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**A**FTER Horsley (2) published the technique of his pyloroplasty in 1919 considerable interest was revived in this type of operation. Erdmann and Carter (1) published a series of 56 cases in 1925 in which the Horsley technique was followed. The results shown in this series were very satisfactory and in reviewing 56 histories and follow ups the authors reported a symptomatic ulcer cure in 94 per cent. Of their series they were able to trace 84 per cent of all cases. My experience with the Horsley pyloroplasty in chronic ulcers has been limited to 3 cases. One had a recurrence within 10 weeks following operation; one died from a pulmonary embolus while in the hospital and the third case has had a gastric disturbance but not a typical recurrence and the roentgenological examination of the gastro-intestinal tract was negative.

In acute perforated duodenal ulcers it appeared that this type of operation would be ideal, as the ulcer could be excised and the stomach left practically in its normal anatomical and physiological state. For that reason between 1923 and 1926 inclusive the Horsley pyloroplasty has been done in 12 cases of acute perforated duodenal ulcers. The result of this series seems to be of some interest. Two cases were operated on in 1923, four cases in 1924, three cases in 1925 and three in 1926. All were males, the youngest being 25 and the oldest 48, the average age being 35 years. The shortest time between the perforation and operation was 4 hours and the longest time was 15 hours.

**Location of lesion.** In each case the ulcer was found on the anterior superior surface of the first portion of the duodenum. The perforation varied from 1 to 8 millimeters. The duodenum was easily mobilized and excision was possible without difficulty.

**Technique of operation.** The technique as described by Horsley was followed and the incision was usually 1 inch on the duodenum and from 1 1/2 to 2 inches on the stomach. The mucosa was always sutured with No. 1 chromic gut. I am aware that Horsley later gave up suturing the mucosa as he felt that it was a factor in causing recurrences. Then a Cushing right angled suture of No. 1 chromic was used followed by a Lembert running suture of No. 1 chromic. The abdomen in all cases was closed without drainage. The excised

tissue was submitted for histological study and each ulcer was shown to have been completely excised.

**Follow up.** One case died from pneumonia on the third day after operation, this case being the one which perforated only 4 hours previous to operation. Two cases have not been followed although they were personally instructed about the importance of returning to the Follow Up Clinic. The fourth case has been symptom free for 3 1/2 years and the fifth case has been symptom free for 3 years but returned 14 months ago with acute appendicitis. This patient was operated upon by me and the duodenum was inspected at the time of the appendectomy and was found normal. The pylorus admitted the tip of the index finger and there were no adhesions about it. A sixth case operated upon 4 years ago had a definite recurrence both clinically and roentgenologically 3 months following the operation. The seventh case operated upon 23 months ago was perfectly well for 15 months when he began having fullness in his stomach which was followed by a nausea and vomiting. Roentgenological examination revealed two thirds of the barium meal retained after 6 hours. He was operated upon 7 months ago and the pylorus was found obstructed but no masses could be detected. A posterior gastroenterostomy was done. Since the second operation the patient has been free from symptoms.

This leaves five cases which have been bothered with abdominal discomfort after eating, the discomfort being similar to ulcer pain but lasting only a few days at a time. Of these cases one was operated upon 16 months ago, another 28 months, the third 33 months, the fourth 42 months and the fifth 45 months. The pain in all these cases had some degree of periodicity, returning at intervals of 2 to 5 months. A roentgenological examination of the gastro-intestinal tract in all five patients was negative. Each patient has had two or more examinations. The patients were given dietary instructions to follow on leaving the hospital. None of these cases had any evidence of cholecystitis or cholelithiasis at the time of the operation. Gastric analysis showed a variation in their total acidity of from 40 to 70 per cent, the average being 53 per cent. Erdmann states that in perforations it has been his custom for years to do

an excision. This he did before Horsley's article was published practically as Horsley's operation for non-perforated ulcers was described but added to his plastic gastrojejunostomy. However having had occasion to reoperate upon one of these patients and having found a much wider duodenum than normal at the site of excision and plastic operation he decided to refrain from doing the added gastrojejunostomy. He fails however to state how many perforated ulcers he has operated upon since giving up the added gastroenterostomy.

#### SUMMARY AND CONCLUSIONS

1. In this series of 12 cases there was one death and two cases cannot be traced.
2. Two patients are entirely well to date one for a period of 3 years and the other for 3 1/2 years.
3. One patient had a definite recurrence and another a pyloric stenosis which necessitated a gastroenterostomy.

4. Five cases were not symptom free and could not be classed as having satisfactory surgical results.

5. This leaves 9 cases which have been followed or a total of 22 per cent that are entirely well following this type of operation.

6. In view of the above results one does not seem justified in continuing to use this type of operation.

I am indebted to Dr. Carl G. Burkhardt for the Furth Surgical Department of the Hospital for the Blind for the use of these cases.

#### BIBLIOGRAPHY

- FRED LANN, JOSEPH A. and CARTER, RUPERT F. The operative treatment of duodenal ulcer with special reference to the Horsley operation. *Ann. Surg.* 9. Mch.
- HORSLEY, J. ST. JOHN. A new operation for duodenal and gastric ulcer. *J. Am. Med. Ass.* 1909, ix, 18.

## RESTORATION OF THE FEMALE URETHRA AND VESICAL SPHINCTER

### AN OPERATIVE TECHNIQUE RESULTING IN URINARY CONTROL<sup>1</sup>

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**C**OMplete loss of the urethra is a comparatively rare condition and its replacement with the creation of a functioning vesical sphincter is a matter of considerable difficulty. The employment of patience and care may however overcome the most serious obstacles. We wish to report a technique leading to a highly satisfactory functional result.

Wardwell states that no two cases are exactly alike and the technique must be improvised to cope with the particular conditions of the individual case. Many methods have been suggested and tried but very few results have actually been effective.

Baker Brown (1863) perforated the anterior vaginal wall obliquely with a trocar below the clitoris and made a puncture wound into the bladder. Through this opening he introduced a silver catheter and eventually after the wound healed obtained a urethra which gave complete continence of urine. provided the bladder was emptied frequently.

Kelly elaborated this idea of the tunnel in the mucosa in the anterior vaginal wall. He dissected an elongated tongue of mucosa from behind the

fistula and pulling it forward over the fistulous opening and into the tunnel made a new urinary canal the anterior half of which was epithelialized. Noble, Sellheim, Pan and others successfully reconstructed the urethra transplanting flaps from various parts of the labia vaginal wall etc. but the restoration of urinary continence following these procedures has not been frequent. Richards and Rosser employed free transplants of fallopian tube and of the vermiform appendix and secured functioning urethras.

The construction of an artificial sphincter is a difficult problem. Deming transplanted a strip of gracilis muscle and brought the urethra through a loop made like a ricket in the end of the transplanted muscle which supplied the urinary canal with a support which had sufficient tonus to allow the bladder to excrete normally.

Ruebsam and Bryzowski employed the pyramidalis and levator ani muscles and obtained satisfactory functional results. The suture of a torn sphincter is not a difficult procedure and is frequently reported but the difficulty lies in cases in which through trauma or slough it has been entirely destroyed.

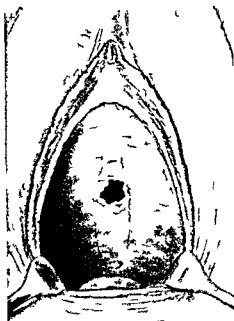


Fig 1

Fig 1 The fistulous opening in the anterior vaginal wall. Outline of the denudation.

Fig 2 Mobilized strip of mucosa turned anteriorly and sutured to anter or flap covering fistula and producing a completely epithelialized tube.

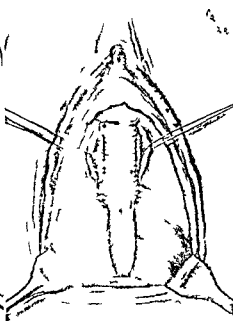


Fig 2

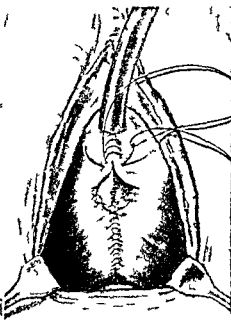


Fig 3

Fig 3 Suture of the vaginal flap over the new urethral canal with a retention catheter in the urethra and closure of the defects beside the fistula (the weak point). The mucosa was sutured through the whole length of the incision.

In the case here reported we attempted to construct a mucosa lined urethra and then at the second stage to improvise a sphincter by employing transplanted strips of levator ani muscle as pedicle grafts encircling the urethra at the neck of the bladder. In view of the difficulty of obtaining a successful functional result in many cases of incontinence it seems worth while to give the history of the case and operative technique in detail.

Mrs. R. colored, aged 30 years, para 4. Patient came into The Lakeside Hospital complaining of frequency of urination since her last pregnancy 5 years ago with almost complete incontinence during the last several months. Her last lab or was somewhat difficult and she had had no menses since that time although her last loss of control had developed only within the last year. There had been also a gradual increase in the amount and duration of the menstrual periods. The belly had been large but she had been no instrumental delivery or operative procedure attempted. The Wassermann was negative.

On examination we found the outlet to be enlarged. There was a moderate cystocele and rectocele. The urethra had been torn away and the situation of the present urethral orifice was almost exactly at the neck of the bladder. The patient admitted a little finger which could be passed through the neck of the bladder. There was a polypoid ectropion of vesical mucosa in the form of a papillary growth which acted almost as a ball valve. The cervix was in good condition. The uterus was anteriorly enlarged to three or four times its normal size by multiple myomata one of which on the anterior surface encroached upon the bladder. The uterus was easily movable and there were no lateral masses.

It was decided merely to attempt the reconstruction of the urethra and bladder sphincter and perform hysterectomy and perineorrhaphy later. There was considerable scar tissue in the vaginal vault which made the denudation somewhat difficult.

**Operation.** The redundant vesical mucosa was carefully excised and the vesical neck narrowed by fine catgut sutures placed deeply enough to involve the muscle of the bladder neck in the area where the mucosal attachment was excised. An incision was then made in the vaginal mucosa at a point approximately 1 centimeter from the midline extending from the fistula to the proposed external orifice of the urethra. A similar incision was made on the other side. This flap was undermined for about one third of its width bilaterally leaving a rather wide point of attachment through its entire length in order to insure its blood supply (Fig. 1). A spade shaped incision was made posterior to the fistulous opening and the flap was turned through 180 degrees to cover the fistula and to form the anterior wall of the new urethra. The transplanted flap of mucous membrane was joined to the strip left on the vaginal wall with a running stitch of fine chromic catgut, thus forming a completely epithelialized tube and replacing the urethral orifice at its proper position (Fig. 2).

A small mushroom catheter was placed in the bladder. The lateral flaps of the anterior vaginal

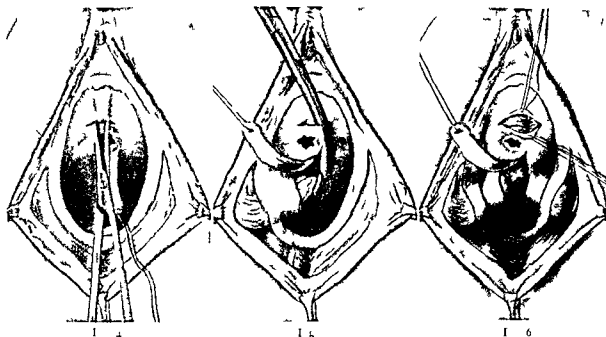


Fig 3

Diagram 1: Initial dissection of the vaginal wall. Diagram 2: Mobilization of the vaginal wall. Diagram 3: Final construction of the sphincter using strips of levator ani muscle.

Diagram 4: Construction of the vesical sphincter. Diagram 5: Completion of the sphincter construction.

Diagram 6: Completion of the sphincter construction.

**Operation** The operation for extension of the urethra with construction of the vesical sphincter was carried out as follows. A flap of mucosa one half inch wide was dissected free from the anterior vaginal wall up to the inferior opening of the urethra where a rather broad attachment was left (Fig 4). A transverse incision one half inch long was made through the vaginal mucosa just anterior to the upper margin of the present urethral orifice and a similar incision was made below the clitoris in the midline by means of scissor dissection and the mucosa was elevated forming a small tunnel for the new urethra (Fig 4).

The employment of strips of transplanted levator ani muscles and fascia as reinforcement for the sphincter was attempted next. A Hegar denudation of the posterior vaginal floor was made and the strips approximately 1 centimeter in diameter were cut from the medial edges of levator ani muscles. The pedicles of the strips were situated almost at the level of the bladder sphincter in the lateral vaginal wall. With blunt dissection tunnel

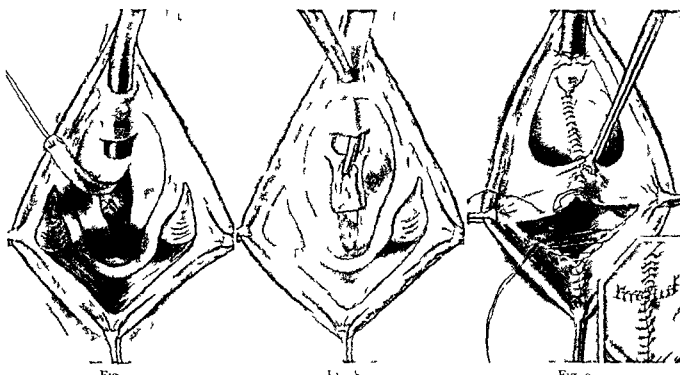


Fig 7 In erection of retention catheter through the new urethra

Fig 8 The mobilized flap of mucosa is pulled forward through the canal in the submucosa to the opening of the present urethra and forms an epithelial

cylin for the anterior wall of the new urethra

Fig 9 Suture of the submucosal fascia and vaginal mucosa is complete and the closure of the mucosa of the posterior vaginal wall is being completed in a T shape and tension

were made under the lateral vaginal mucosa on either side of the urethra to accommodate the muscle transplants. The two strips of muscle were pulled up to the bladder neck (Fig 5) and were crossed and sutured anterior to the urethra and the ends approximated posterior thus forming a complete ring of muscle (Fig 6). A small mushroom catheter was inserted at this point through the tunnel in the anterior vaginal mucosa and between the two strips of levator ani muscle (Fig 7). The flap of vaginal mucosa which had been dissected free from the cervix (Fig 4) was brought through the tunnel along the anterior surface of the catheter to form the anterior outer surface of the new urethra (Fig 8). Two interrupted chromic No. 00 sutures were taken in the angle of the pedicle near the neck of the bladder on each side to repair the two small lateral defects where the mucosal flap was bent sharply upon itself as it entered the tunnel. The denuded portion was closed with a continuous chromic catgut suture the superficial fascia being closed first with mattress sutures (Fig 9). Near the sphincter of the bladder the vaginal mucosa was dissected rather far back to allow its better mobilization. This was everted somewhat by deeply placed sutures thus creating a bulkhead over the neck of the bladder to reinforce the small lateral defects at the edges of the

new urethra. The perineorrhaphy was completed and the raw edges of the levator ani muscles approximated with interrupted chromic catgut sutures. The superficial fascia and the mucosa were closed with continuous sutures.

The transplanted levator ani muscles could not be felt lying in the upper lateral walls of the vagina. The vagina barely admitted two fingers and was the source of some anxiety to us because we feared dyspareunia might result. The point of greatest narrowing was at the neck of the bladder about 1.5 inches from the outlet. The urinary stream now was diverted into a canal the posterior wall of which consisted of the united levator muscle transplants and suture line (Fig 5). We failed to examine the subsequent degree of epithelialization of the urethra because dilatation of the newly formed sphincter by urethroscopy seemed unwise.

Immediate convalescence was uncomplicated. The catheter was removed on the twelfth postoperative day and the patient was completely incontinent. She had a chill the following day with headache, malaise and leucocytosis. The urine showed a few pus cells. The temperature returned to normal in 3 or 4 days. Careful investigation of the urine, pelvis and lungs failed to reveal the source of the chill. The catheter was reinserted without discomfort and there was no leakage



The catheter was removed on February 6, 15 days later and the patient had fair voluntary control of urination. Occasionally the urine escaped without her knowledge, but by emptying the bladder fairly frequently she was able to maintain a fair degree of continence at the time of her discharge from the hospital.

We have made periodical examination of the patient since the operative procedure. The last examination, 10 months after the operation, revealed the urethra measuring approximately 1 inch in length from the vesical neck to the orifice. At least one half inch of urethra was lost by slough following the second operation. The vaginal orifice at its narrowest point admits two fingers freely and the patient says that she is perfectly comfortable and has practically as good control of urination as at any time in her life.

It is probable that in the light of the outcome of this case we will employ only the procedure shown in Figures 4, 5, 6, 7, and 8 in future cases in which restoration of the urethra and sphincter is indicated.

At examination approximately a year after operation we found the patient fully continent regardless of the amount of the fluid intake except for the very occasional loss of a few drops. She has no nocturia and the use of a pad is never necessary. It is noteworthy that firm pressure exerted on the midpoint of the vaginal floor at the outlet pulls on the levator muscle transplants and urine flows from the urethral orifice which promptly stops when the pressure is removed and the urethral orifice again becomes slit like as the phincteric action again comes into play.

The omission of the perineorrhaphy might have been an advantage as a scrutiny of the mechanics of revamped levator muscle attachments shows. As has been stated above, any pull on the perineal floor also pulls down on the urethral floor which favors leakage.

It appears from the examination of urinary function in this case that this result is not merely dependant on narrowing the urethra at some point by the interposition of an artificial bulkhead; the patient is able to void as well as to stop urination at will and to produce visible voluntary contraction of the sphincter.

We believe that we are justified in recommending further trials with levator muscle transplants in the repair of vesical sphincter defects in the female.

# REFERENCES

- Brj v A T ues v r f h d Sph ct plat k  
be de H k t nz A h f kl Ch 19 3 11
- Br B Tl e f t f l th B t M J  
863 30  
D M C C T pl t t f th k ac l m l th  
t tm t f t f J Am M As 9 6  
l 8 3  
N C The f m t f th f m l th with  
p t f a ca Am J Ob t 9  
N BLE C k L H Gyn l gy d Abd m l  
N g y Ph l j l ph a d Lo d W B S d Co  
9 8 5  
W V C o GE G O t t tm t f c bl  
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Id m R t ct f th th ft mpl t l s  
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# A CONSIDERATION OF BLADDER TUMORS WITH SPECIAL REGARD TO THE THERAPEUTIC MEASURES BEST SUITED TO THE DIFFERENT TYPES<sup>1</sup>

By WILLIAM A. FRONTZ, M.D., BALTIMORE, MARYLAND  
 F m h J m B h B d y l g H t t J h H p k H p l

**B**EFORE the introduction of fulguration and radium therapy the only means at our command for the treatment of bladder tumor was surgery. The necessity of differentiating one type of bladder tumor from another was a matter of trivial importance.

The first effort of the surgeon for the cure or destruction of the bladder tumor entailed suprapubic exposure and cauterization by means of the hot iron or by the more modern forms of cautery. If the tumor was pedunculated or even sessile but non-infiltrating the immediate results were entirely satisfactory in that the growth could be completely eradicated. As these cases were followed subsequently however it was soon found that bladder tumor had an extraordinary tendency to recur. In many instances in which the operator had succeeded in removing a simple single growth multiple tumors were found some months later. A second operation with destruction of the recurrent tumors would again be followed by recurrence. While cures were occasionally obtained and freedom from recurrence was ultimately secured this happy result was exceptional most of the patients eventually dying of extensive carcinoma of the bladder. The results were so discouraging that many urological surgeons advised operating only in cases of necessity for the relief of some complication. The failure of the surgical procedure in this type of tumor is due not so much to the procedure itself but to the lack of means of treating recurrence. Tumors of this type can be thoroughly and effectively destroyed by cauterization but the growth of new tumors cannot be prevented.

Formerly when the tumors were infiltrating especially deeply infiltrating very few if any satisfactory results could be secured by any methods of cauterization then available. The rapid realization of the ineffectiveness of these methods for the cure of infiltrating tumor led the bolder surgeons to attempt resection. The results obtained by the radical resection of the tumor area with a margin of healthy bladder wall gave surprisingly excellent results and many surgeons were led to adopt this method absolutely in tumors of the non-infiltrating type. The results however in this latter group were not as

satisfactory so far as ultimate cure was concerned because of the greater tendency to recurrence. The suprapubic exposure of these non-infiltrating types of tumors resulted not infrequently in tumor implantations at points in the bladder previously uninvolved as well as in the suprapubic tract.

With the introduction of fulguration by Beer in 1910 there began a new era in the treatment of the more benign papillomatous tumors. More recently the introduction of radium has proved of great value in the more malignant forms of tumor.

The object of this paper is to show the necessity of careful differentiation of the various types of tumor and to point out forms of treatment which experience has shown will give the best results. For example in one group fulguration will be successful in another group resection is the method of choice in another radium applied to the surface of the tumor will suffice in another in which fulguration resection or surface application of radium is not applicable implantation of radium in the form of needles or as the emanation will yield results in cases hopeless to any other form of therapy.

It has usually been our custom in the classification of bladder tumors to differentiate one tumor from another histologically. Thus papillomata were divided into the benign and malignant types. In the former group were included those tumors in which the epithelium lining the connective tissue axis had a palisade arrangement at the base above which were several layers of oval long tailed cells all of which were of uniform size and shape and took the stain with uniform intensity. The papilloma was considered malignant when this uniformity in the size shape and staining characteristics was lacking or when the connective tissue axes of the tumor were infiltrated.

When infiltration of the pedicle of the tumor or the bladder wall was present the tumor was no longer regarded as a papilloma but was termed a papillary carcinoma. It should be noted however that in many of these malignant types of tumor particularly the malignant papilloma many portions of the tumor often the major part

presented a perfectly benign appearance histologically. On the other hand it was occasionally observed that in an apparently benign tumor a careful and painstaking search would finally establish a malignant character. In many of these cases therefore where a single block of tumor tissue was removed for section a diagnosis of the benign type was made whereas if other specimens of the tumor had been examined definite histological proof of malignancy would have been forthcoming.

The classification to be adopted in this paper is not one based upon the histology of tumors as this has proved in our experience to be of very little practical value. The difference histologically between the benign and malignant papilloma is of no practical value. Both types of tumor will usually respond equally well to the same type of therapy. The only practical advantage of this differentiation is that one can predict somewhat more accurately that there will be a greater tendency to recurrence in the case of the malignant papilloma. A section of the flat non-infiltrating papillary carcinoma may not differ at all from the histological picture presented by the tissue obtained from the surface of the papillary tumor the base of which is deeply infiltrating. If one were to depend upon the histological picture alone the form of therapy successful in the one case should be equally successful in the other. Our practical experience however has shown distinctly that this is not true. Radium applied to the surface of the non-infiltrating papillary carcinoma will usually effect its removal but when applied to the deeply infiltrating tumor it has been found to be entirely useless and even harmful.

In a long series of cases pieces of tumor were removed in all cases in which this was possible and the histological picture was compared with the cystoscopic appearance of the tumor. It was observed that the data obtained from careful cystoscopy, symptoms and palpation furnished very much more reliable information as an aid to the selection of the form of therapy which would yield the best results.

The pathologist can tell us with more or less accuracy whether or not the tumor is of the benign or malignant type. He cannot however tell us the degree of malignancy nor the extent and degree of involvement. This information is more accurately furnished by the cystoscope. The pathologist rarely furnishes any information of value to aid the urologist in the selection of the therapeutic procedure best adapted to any given case.

It is proposed that from the standpoint of therapy bladder tumors be divided into two general groups the differentiation being based upon the presence or absence of infiltration of the tumor pedicle or bladder wall. While errors in interpretation are bound to occur our statistics show that untreated tumors which are clean and vascular and not associated with cystitis or evidences of edema about their bases should be regarded provisionally at least as non-infiltrating and treated by endovesical therapy. These tumors which will include papillomata and the clean vascular sessile type of papillary carcinoma are usually not very difficult to recognize. The same may be said of the more extensive infiltrating tumors. The greatest difficulty in a correct cystoscopic interpretation will be presented by tumors in which the infiltration is confined to the pedicle or extends only superficially into the bladder wall or in which because of the size of the tumor inspection of the mucosa contiguous to the pedicle is impossible. However in this particular group of tumors in which there is uncertainty as to the degree of involvement it has been our custom to regard them as being on to the non-infiltrating type and treat them accordingly. If they respond to this treatment well and good if they do not little has been lost for it is generally believed that there is slight risk of early metastasis in superficially infiltrating tumors.

Practically all of the non-infiltrating types of tumor will respond to the so called endovesical methods of treatment which consist of fulguration, the application of radium to the surface of the tumor and to a combination of the two procedures. Most of the papillomatous tumor will respond to fulguration alone. There are certain tumors of this group however which are resistant to this method of treatment and it is our custom in all papillomata except the villous type to give from 300 to 600 milligram hours of surface radium preliminary to fulguration. A experience has shown that the tumor is thereby rendered more vulnerable to the procedure.

In one of our early cases in which a histological study had resulted in a diagnosis of malignant papilloma the value of preliminary radium was most convincing and led to the very frequent employment of this therapeutic measure combined with fulguration in the papillomatous type of tumor. This patient was first treated by fulguration at monthly intervals for a period of about 6 months. At each treatment the tumor which was  $1\frac{1}{2}$  centimeters in diameter was vigorously fulgurated and apparently completely

destroyed. At the next cystoscopy however the tumor gave no evidence of ever having been treated being of the same size and appearance as noted originally. After 6 months of fulguration 3 hourly treatments of 100 milligrams of radium applied to the surface of the tumor were followed by vigorous fulguration which resulted in its eradication. The patient died of pneumonia 4 months later and a careful autopsy gave no evidence of recurrence or metastasis.

If on the initial cystoscopy surface necrosis is noted in a previously untreated tumor or if a tumor has been subjected to fulguration and the slough fails to separate promptly the tumor should be regarded as infiltrating and not suitable for endovesical therapy. The proper method of attack will often differ with the personal preference of the operator but most authorities are agreed and our statistics support the conclusion that resection with a wide margin of healthy bladder wall will give the best results.

Thus in 68 cases of cancer of the bladder in which resection was carried out there were 6 postoperative deaths. Twenty of the patients or 32 per cent were well for 1 year or more while 13 or 20 per cent remained well for 3 or more years. It is interesting that in this series of 68 cases the ureter was transplanted 15 times. In this latter group there were 6 or 40 per cent cures 4 of the patients being alive and well 9 years after operation and 2 dying from other causes several years after resection.

Multiplicity of the tumor or involvement of the trigone or vesical orifice may render resection impossible and a choice between radium implantation or diathermy must be made.

While our experience in the use of diathermy in the treatment of infiltrating tumors of the bladder is so limited that it is unfair to draw any definite conclusions regarding its relative value our personal preference inclines us to employ radium implantation in these cases. The technique we have followed consists first in free mobilization of the bladder followed by a surface destruction of the tumor by means of cautery thus diminishing the likelihood of tumor implants. Platinum points each containing 1 milligram of radium element are then plunged into the base of the tumor 1 milligram being used for each square centimeter of tumor surface. In cases of extensive malignancy particularly if the vesical orifice be involved the small points are reinforced by spears each containing 10 or 15 milligrams of radium element. The radium is allowed to remain *in situ* for from 4 to 48 hours depending upon the degree of bladder wall involvement. In this

way a radiation totaling 100 to 400 milligram hours can be obtained. In 34 cases of bladder cancer in which this technique was employed 6 patients (17 per cent) were well for 1 year or more.

The employment of cautery in the treatment of bladder tumors should be limited to the surface destruction of the tumor preliminary to resection or implantation of radium. That this therapy will succeed in destroying superficial neoplasms is undoubted but this type of tumor is best and most safely handled by endovesical means.

In recent years many claims have been advanced favoring deep X-ray therapy. In our experience this agent has been of greatest value in ameliorating the pains of nerve involvement. In 10 cases of extensive and deeply infiltrating tumor this method alone was employed and in none of these cases was any marked improvement noted. In 37 other cases receiving radium and deep X-ray in combination an apparent cure was obtained. It seems apparent therefore that this form of therapy is most effective if the tumor is first subjected to a series of radium treatments.

#### CONCLUSIONS

Much of the confusion in the past regarding the most appropriate treatment to be applied to any given case of bladder tumor is the result of the present classification which is based upon the histological findings in fragments removed by cystoscopic means. We have repeatedly demonstrated the great possibility of error in basing a diagnosis upon the histological study of a single specimen thus obtained.

So far as the so called papillomata are concerned the differentiation between benign and malignant forms is of no practical import from the standpoint of therapy as both respond to a combination of radium and fulguration.

In case of the so called papillary carcinoma greater confusion is present as the non infiltrating tumor of this type may present a histological picture identical with the tissue obtained from the surface of a tumor the base of which has extensively infiltrated the bladder wall. An early differentiation of these two types of tumor is most essential as the former usually responds to surface application of radium and the latter requires an extensive surgical procedure.

It is believed that much of the confusion created by the histological classification will be obviated by replacing it with one based upon the cystoscopic findings alone. Under this classification tumors would be designated as either non infiltrating or infiltrating. The experienced cystoscopist will usually have little difficulty in making



examination disclosed a sinus tract leading from the gall bladder to a perinephritic abscess which had subsequently extended to the kidney where a gall stone was found. Another had previously passed down the ureter to the bladder and been voided.

Perforations may occur without any attending symptoms. Reimann and Bloom (11) have published the autopsy findings of a patient who succumbed to empyema following lobar pneumonia. Although the patient was jaundiced there was no previous history of gall bladder disease. Postmortem examination revealed a biliary fistula between the gall bladder and pyloric portion of the stomach. A calculus about 1 centimeter in diameter was located in a small cystic cavity of the stomach wall completely separated from the lumen of the viscus.

Cases of intestinal obstruction by large gall stones are on record however in which no fistula existed and the only explanation is that the stone must have passed by way of the biliary ducts. Murphy (9) cited an instance in which the common duct was dilated sufficiently to allow the passage of a stone 4 inches in circumference. Morgagni quoted by Martin reported a case in which the common duct was dilated to the size of the stomach and filled with stones.

Approximately one half the patients recover without operative aid. The stone is gradually forced onward through the small bowel into the colon and out through the rectum. Murphy states of 125 cases 70 after various and repeated colics, emesis, peritonitis, ileus etc. were cured spontaneously by the passage of the stones per anum. In Wagner's series 93 passed the stone by rectum, 159 were operated on and 8 died without operation.

The importance of early diagnosis cannot be over emphasized. Martin states the diagnosis of gall stone ileus is seldom made with certainty. On the contrary Murphy believes that ileus due to a gall stone which has perforated through the gall bladder into the intestine may have no preceding jaundice but the inflammatory symptoms which accompany such a perforation ought to suggest the diagnosis. Three of the 4 cases recorded below presented symptoms characteristic of the type of indigestion which so frequently accompanies disease of the biliary system. A detailed inquiry into the past history usually will enable one to make a correct diagnosis.

The clinical picture is that of sudden acute intestinal obstruction or recurrent attacks of partial obstruction. Visible peristalsis is rarely present. Local tenderness as a rule is not marked sensi-

tiveness beneath the right costal margin in the region of the gall bladder offers a valuable diagnostic clue in cases of recent perforation. Generalized abdominal spasm is indicative of general peritonitis.

Subcutaneous and intravenous administration of salt solution before operation forms a very important adjunct in treatment. Orr and Haden (10) have recently shown how seriously the body chlorides become depleted in patients with intestinal obstruction.

When toxæmia is marked all supportive measures should be instituted before the patient is taken to the operating room.

The length and type of operative procedure depends entirely upon the patient's general physical condition. In a great many cases removal of the stone and temporary enterostomy should suffice. This offers an additional advantage in allowing free drainage to the toxic intestinal contents retained above the point of obstruction. If the bowel has been obstructed for only a short time the intestine may be closed with safety. Cholecystectomy should seldom be considered. Many patients relieved of their obstruction die because of an unduly prolonged operative procedure. The gall bladder may be removed at a later date much more safely and conveniently. Lateral enterostomy should likewise be avoided if possible. Brown (3) advises removing the stone through a transverse incision in order to avoid such constriction of the intestinal lumen as occurs when a longitudinal incision is closed and inverted. Davis (5) suggests transverse closure of a longitudinal incision.

Statistics regarding the mortality are extremely variable. The following table is striking.

TABLE II — A TABULATION OF THE MORTALITY REPORTED BY VARIOUS AUTHORS FOLLOWING OPERATIONS FOR INTESTINAL OBSTRUCTION BY GALL STONES

Author	Number of	
	Operations	Deaths
Wagner	150	48
Courtoisier	125	44
Schuller	82	56
Hermann	92	63
Benning Wilms	64	33
Honma	34	41
Lobstein	31	61
Möller	22	82
Nannyn	13	92

Although the majority of patients with acute intestinal obstruction by gall stones are stout women beyond middle life there seems little excuse for such an astoundingly high mortality. It



firmly impacted. The intestine below this point was collapsed. Exploration of the upper abdomen revealed a mass of adhesions between the gall bladder and duodenum. The loop containing the calculus was delivered all off from the operative field and the stone removed through a small incision. A Mixture tube was sewed into the rent in the small bowel and the loop of intestine approximated to peritoneum by a few chromic sutures. When the Mixture forces were removed a large amount of foul fecal like substance escaped from the proximal intestine. A small cistern drain was inserted through the peritoneum to the region of the operative field. The abdomen was closed with a few interrupted sutures in the peritoneum, chromic reinforced by silk worm gut in the fascia, and closed in the skin. The patient left the table in fair condition.

The specimen consisted of a large brown gall stone measuring approximately 3.5 centimeters in diameter. On section it appeared to be made up of many layers of cholesterol.

**Postoperative course.** The patient made a fair recovery from the anesthetic but became irrational on the first day after operation. The urine contained no sugar and a trace of acetone. She was given digitalis and insulin. On the second day she was nauseated and vomited several times. Drainage from the enterostomy was copious. On the third day she did not respond well, the skin was cold and clammy. The urine was still sugar free. Blood sugar was 0.51 per cent, blood urea nitrogen was 109 milligrams per 100 cubic centimeter. Diets of glucose and insulin were continued. She died on the afternoon of the fourth postoperative day.

**Necropsy.** The gall bladder was shrunken and bound down to the liver and duodenum by many firm fibrous adhesions. The wall was thick and the mucosa necrotic. There was a pocket about the size of a walnut which had contained a large solitary stone. An opening was found between the duodenum and the lumen of the gall bladder. A small probe could be passed into the pancreatic and hepatic ducts but the cystic duct was entirely fibrosed. A small irregular stone was found in the gall bladder near the beginning of the cystic duct.

The duodenum was opened, showing a low grade duodenitis was present. The mucosal surface was injected, edematous and stained with bile. A small acute duodenal ulcer, 1 centimeter in diameter, was found on the posterior wall about 6 centimeters beyond the pylorus.

**CASE 3.** A widow aged 72 years was admitted to the hospital complaining of spasmodic abdominal pain and vomiting.

**Past history.** For 10 years the patient had been subject to mild indigestion characterized by belching of gas, sour eructations, slight pain in the epigastrium and right hypochondrium. These attacks bore no relation to meals. Light months previous to admission he had one transient attack of sharp knife-like pain in the right upper quadrant of the abdomen beneath the costal margin accompanied by nausea and vomiting. She had never passed watery bloody or clay colored stool nor been jaundiced.

**Present illness.** Three days before admission on the patient was suddenly seized with severe epigastric pain and vomiting. The pain was cramp-like in character and recurred every few minutes until she entered the hospital. At first the vomiting consisted of recently eaten food but later changed to brownish watery fluid. There was no fecal odor. Her bowels moved normally on the night before the onset of the present illness. Subsequently she passed no fecal material but a small amount of flatus with the aid of enemata.

**Physical examination.** The patient was a well developed and pre-pressed elderly woman lying in bed in some discomfort.

She regurgitated thin brownish sweet smelling material from her stomach every few minutes without retching and occasionally cried out with pain. Heart and lungs were normal. Abdomen was lightly distended but showed no visible peristalsis or localized swelling. There was diffuse tenderness most marked around and just above the umbilicus. The left lower quadrant was dull to percussion. No masses were palpable. During the interval between pains there was no spasm of the abdominal musculature.

**Clinical pathology.** On admission the patient had a temperature of 96.4 degrees, pulse rate was 111, respiratory rate 8. Leucocyte count was 9,400, hemoglobin 90 per cent. Urine showed an occasional erythrocyte and a few leucocytes per high power field.

**Postmortem diagnosis.** Acute intestinal obstruction due to impacted gall stone, chronic cholecystitis and cholelithiasis.

**Operation.** Removal of impacted gall stone from terminal ileum for acute intestinal obstruction, incidental appendicectomy under ether anesthesia.

The abdomen was opened through a right paramedian incision. No malappearing transverse colon presented there was a moderately dilated loop of small bowel located in the right iliac fossa. A large gall stone was found impacted in the terminal ileum at the ileocecal valve. The terminal ileum was dilated. The stone was milked gently upward for a short distance the loop containing the stone delivered into the wound and carefully wallied off from the operative field. Enterostomy clamp were lightly applied above and below and the stone removed through a longitudinal incision. The bowel was repaired with a continuous stitch of zero chromic catgut through the mucosa and submucosa reinforced by a similar stitch in the lumen. All layers except the mucosa. A normal appearing appendix was then removed in the usual manner. The upper abdomen was explored and a very hard mass felt beneath the right costal margin. This consisted of thick calcareous gall bladder containing multiple calculi and adherent to the duodenum and stomach. The abdomen was closed without drainage. The patient was in excellent condition. The calculus was about 2 centimeters in diameter, cubical and had large facets on two sides.

**Postoperative course.** The patient, although slightly irregular in temperature for a week and occasionally regurgitated fluid and food. The pulse rate rapidly subsided to normal. The wound healed perfectly. On the fifteenth postoperative day, a complete enema studies of the gastrointestinal tract showed a small hypertonic stomach. The duodenal cap filled well and emptied freely. There were severe indistinct shadows just above the pylorus which were suggestive of gall stones. No further surgery seemed advisable at that time and the patient was discharged.

**CASE 4.** A married white woman 56 years of age presented the hospital complaining of abdominal pain and vomiting.

**Past history.** The patient had had rheumatic fever when she was 3 years old and typhoid fever 11 years later. Appendicectomy was performed for acute appendicitis at the age of 43 and the abdomen was drained. For many years she had suffered with dull pain and distress in the epigastrium, gaseous and sour eructations coming on after meal and not relieved by food. During the year previous to the present admission these symptoms had become much more frequent and persistent. She had never been jaundiced and had passed no bloody, tarry or clay colored stool. Her bowels moved daily without catharsis.

**Present illness.** The attack began one day before readmission with a dull gnawing pain in the periumbilical region gradually becoming so severe that the patient shrieked with agony. Vomiting commenced and continued hourly.



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# COMMENT

In the first case the diagnosis of intestinal obstruction by an impacted gall stone was obvious. Perforation undoubtedly occurred during the attack of abdominal pain and vomiting one year previous to admission. It is well known that a gall stone may be dormant in the intestinal tract for some time without causing any symptoms. The second patient presented no past history referable to disease of the gall bladder and an accurate diagnosis was impossible. She did not

succumb to the toxæmia of intestinal obstruction but to hyperglycemia and renal insufficiency. The third case illustrates the importance of an accurate interpretation of the past history. Although no characteristic pain or jaundice had ever been present the type of indigestion which the patient described was entirely compatible with that which so frequently accompanies chronic cholecystitis and cholelithiasis. In the fourth case it was necessary to differentiate between an impacted gall stone and adhesions at the site of the old operative wound. A detailed analysis of the past history turned the balance of evidence in favor of the former diagnosis.

## CONCLUSIONS

Cases of acute intestinal obstruction by impacted gall stones are not infrequent. The stone reaches the intestinal tract either through a perforation within adhesions between the gall bladder and some neighboring viscus or by way of the biliary ducts. The clinical picture is that of acute intestinal obstruction engrafted upon a previous history of cholecystitis and cholelithiasis. Although a certain number of patients are cured spontaneously by passage of the stone, the danger of peritonitis is great and operative aid should be administered early. The stone should always be removed and the subsequent operative procedure limited to accord with the patient's general condition. Subcutaneous and intravenous administration of saline solution is of distinct value in combating toxæmia.

## BIBLIOGRAPHY

1. BARTH LYN Quoted by M t  
B n r r C Obstru t f s m l l test by g l l  
st es B it M J 9 6 36
2. B n J S Call st il S g Gyn c & Ob t  
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4. DAVI N P A t t t l b t r c t by a g l l  
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5. I L S E R H L The g a n d d e n f g l l  
t Med N 398 iv 64
6. MARTIN F l t t n l b t r u c t o n d t o g a l l t s  
A S u g 9 2 l 725
7. MOO E G A Call tone l e s B t o M & J 9 5  
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8. M L R H Y J Gall st d e a d i t e l a t t n  
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10. WACNER A l l s d h Gall t e D t s c l e  
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## SURGERY, GYNECOLOGY AND OBSTETRICS

SEPTEMBER 1928

### ACCUMULATED BILE DISPLACING THE LIVER

**S**UDDEN changes in intra abdominal pressure may occur secondary to operative procedures altering the relative position of the intra abdominal viscera sufficiently to produce a train of events which unless relieved may risk or take the patient's life. Acute abdominal distention is frequently associated with an increasing pulse rate, lowering of blood pressure, cold and sometimes cyanotic extremities, evidences of circulatory disturbances of considerable magnitude.<sup>1</sup> Relief of distention by resumption of intestinal motility, whether spontaneously or induced by enterostomy or cæcostomy, is usually associated with and followed by a return of the circulation to normal, provided the factor of peritonitis does not exist. Sudden increases in intra abdominal pressure resist excursions of the diaphragm and respirations are labored and increased. Here again with the relief of the abdominal distention and a return of intra abdominal pressure to normal limits, breathing becomes easier and the rate of respiration is decreased.

Such changes are rare however in the relatively innocuous chronic abdominal distention occurring with abdominal ascites ovarian and pancreatic cysts and subdiaphragmatic abscesses the accumulation of which is slow enough to permit compensation for visceral displacements Time and physiological adjustment play an important role also in the toxemia of duodenal fistula and duodenal stasis Active and intense in the acute stage it disappears as the condition becomes chronic

It should not be assumed that circulatory and respiratory changes occurring in such cases are due alone to alterations in intra abdominal pressure or to changes in the relative position of intra abdominal viscera for the effect of causative factors in intestinal stasis and the toxemia accompanying interference with intestinal motility without distinction interjects elements which are difficult to interpret and may differ in each case

Occasion presented to study the effect of displacement of an intra abdominal viscus in a deeply jaundiced patient in whom the factor of causation was known and disturbances in intestinal motility did not exist. From 500 to 700 cubic centimeters of bile accumulated between the diaphragm and liver within 1 hours immediately following an anastomosis between the stump of the common bile duct and an opening made in the duodenum for the relief of a stricture involving the lower portion of the common bile duct. An accurate anastomosis was possible because the common bile duct proximal to the stricture was about three times normal size. In the

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dissection of the stump of the duct from the under surface of the liver preparatory to making the anastomosis a small nick was made in the duct near the hilum of the liver which was immediately closed with suture. This was probably the point of exit of bile. Although the area of the anastomosis was drained sufficient bile accumulated between the diaphragm and the liver to cause displacement of the latter.

A syndrome characterized by an exceedingly rapid pulse rate low blood pressure a rapid rate of respiration a cold limp skin and semiconsciousness resulted from the downward displacement of the liver producing in turn interference with circulation in the inferior vena cava. With the patient in such condition opening of the abdominal incision in the patient room was rewarded by the gushing discharge of bile from the area between the dome of the liver and the diaphragm. Immediate improvement characterized by a drop of pulse rate from 165 to 115 a decrease in respiratory rate and a return to consciousness occurred in a few hours. From this time on convalescence was not complicated and complete recovery finally resulted.

Experimentally it was shown that downward displacement of the liver produces disturbances of the circulation in the inferior vena cava resulting in changes in blood pressure pulse rate and respiratory rate similar to those which occurred in the patient. Furthermore the removal of the factors displacing the liver was followed both clinically and experimentally by the return to normal of the pulse rate blood pressure respiratory rate and by rapid and striking improvement in the general condition.

WALTMAN WALTERS M.D.

## THE EARLY TREATMENT OF FRACTURES

TECHNIQUE of operations and improvements in methods of treatment have a strong influence on end results but of far greater importance in many morbid conditions are early diagnosis and prompt action. The history of acute appendicitis and perforated gastric and duodenal ulcer illustrates this very definitely. More recently we have seen great improvements in the end results of fractures. Much has been accomplished in the refinement of methods. The use of traction and suspension and a clearer understanding of the advantages and dangers of open treatment have contributed to bettering our results. But the main reason why the disability following these injuries is decreasing is that the medical profession and the public are realizing the importance of immediate action. In an overwhelming majority of cases today the first entry in our records shows that — hours or — minutes ago patient fell etc instead of — days. We are understanding better what takes place at the site of fracture during the early hours and days after injury. We are realizing that the golden opportunity for anything like exact approximation of fragments is limited to that period *before* the process of repair in both bone and soft parts has really started. We have seen cases in which the attendant at the playground or the policeman in the park has accomplished a reduction which the experts might have failed to produce the next day. No longer do we wait for the swelling to go down—that terrible advice which came down through so many blind generations—but proceed immediately to restore as far as we can the normal contour of the bones. Fractures are being regarded as emergency cases and given precedence over other less immediate problems.

With the appreciation of what can be accomplished in the early hours we are also becoming less tolerant of improper reductions. Many a 'satisfactory reduction' of twenty years ago no longer passes muster but repeated or prolonged attempts are made. We may have to accept some shortening in oblique or spiral or badly comminuted fractures but any overriding in a transverse fracture demands explanation.

Another reason for improvement in results is that with the more exact knowledge of the details provided by the X ray our attempts at reduction are much gentler than they were when the external signs and symptoms were our only guides. We no longer proceed by rule of thumb but make our manipulations along definite lines. With more exact knowledge of just what we wish to accomplish we are able to proceed with less additional trauma to the ends of bones and to soft parts.

Lastly improved results can be attributed to a more definite realization of the fact that the soft parts are injured as well as the bone that treatment which is good for one is often bad for the other and that the maintenance of function of the muscles and joints during the period of repair of the bone will decrease both the amount and the duration of disability.

More prompt action, more exact replacement of fragments by gentler means and more careful attention to soft parts are improving results.

The public is learning to come more promptly for help and we medical men are appreciating more clearly what we can do. Nevertheless until this modern attitude is still more widely adopted the results of improperly treated fractures will continue to be blots on the escutcheon of American surgery.

WILLIAM DARRACH

# MASTER SURGEONS OF AMERICA

## DEFOREST WILLARD

**A**MONG Pennsylvania's most noted surgeons was the late DeForest Willard of Philadelphia. Dr Willard's family came to this country in 1637. His first American ancestor Major Simon Willard was one of the founders of the city of Concord, Massachusetts, and was the first commander in chief of the British forces in America. Of his ancestors, one was provost of Canterbury in 1118, and another was baron of Cinquepore in 1477. Dr Willard was also in direct descent of the third and the fifth presidents of Harvard College. From Massachusetts his branch of the family came to Connecticut, the settlement in Newington being made by the grandson of Major Simon Willard.

Dr Willard was the son of Daniel H. and Sarah Maria (Deming) Willard, and was born at Newington, March 3, 1846. He graduated from Hartford High School in 1863. He passed his entrance examination to Yale College, but was unable to take up his college course on account of difficulty with his eyes. In 1864 he attended Jefferson Medical College in Philadelphia for one year. He was denied admission to the United States Hospital service during the Civil War on account of his lameness, but was accepted by the United States Sanitary Commission, and saw service at the siege of St. Petersburg in 1865. At that time he was placed in charge of a ward at the Army Hospital at City Point, and performed all the services of a full surgeon. In 1867 he received the degree of doctor of Medicine from the University of Pennsylvania, and was resident physician to the Philadelphia General Hospital for the next eighteen months. In 1869 he was appointed instructor in the University of Pennsylvania Medical School, and from that time until his death he served the University as demonstrator, quiz master, associate professor, and professor. The chair of orthopedic surgery was created for him in 1889.

During his lifetime Dr Willard held many high positions in hospital, medical, and scientific associations. He was chairman of the surgical section of the American Medical Association, president of the American Orthopedic Association, president of the Philadelphia County Medical Society, and president of the Medical Board of the Presbyterian Hospital. He was also vice president of the International Congress of Tuberculosis in 1908. He organized and founded the Orthopedic Department of the University Hospital, and this department is now



DEFOREST WILLARD  
1846-1910



known by his name. He was organizer and surgeon in chief of the Widener Memorial Home for Crippled Children, surgeon to the University Presbyterian Germantown, Jewish and Municipal Hospitals, consulting surgeon to the Atlantic City Hospital, Children's Seashore Home, Home for Incurables and Home of the Merciful Saviour. In 1876 he was assistant medical director to the United States Centennial Exhibition in Philadelphia.

In addition to his purely professional work, he was on the board of managers of the University Hospital, Pennsylvania Training School for the Feeble Minded, Union Benevolent Association, Academy of Natural Sciences, New England Society and the Young Men's Christian Association.

Dr. Willard was a voluminous contributor to medical literature, most of his writings dealing with the specialty of Orthopedic Surgery, in which he was most interested. Besides numerous other articles, he wrote the chapters on Orthopedic Surgery for the Ashhurst International Encyclopedia of Surgery, and in 1910 published his book on the *Surgery of Childhood*, which is considered an authority on the subjects of which it treats.

Dr. Willard was never known to neglect any of the offices or the many positions which he held in his long career. He possessed an unusual degree of surgical judgment and operative skill to which was added a remarkable personal magnetism. Among his university students he was beloved because of his high ideals and constant kindness.

He received the honorary degree of A. M. from Lafayette College in 1882 and Ph. D. degree in 1885. He was married September 13, 1881, to Elizabeth M. Porter, daughter of the Honorable William A. Porter and Emma (Wagner) Porter. Dr. Willard died at his country home at Lansdowne, Pennsylvania, on October 14, 1910.

DEFOREST P. WILLARD



# THE SURGEON'S LIBRARY

## OLD MASTERPIECES IN SURGERY

By ALFRED BROWN, M.D. FACS OMAHA, NEBRASKA

### THE TETRAPLON OF AETIUS OF AMIDA

IN the little town of Amida in the valley of the upper Tigris River situated in Mesopotamia somewhat east of Cappadocia northeast of Ur of the Chaldees and southwest of Mount Ararat Aetius was born probably in the early part of the sixth century. The locality is famous at this period and its history goes back far into ancient times being important in Old Testament days for if one looks at an old Bible map he will find near it Nineveh, Ctesiphon, Mount Ararat, the upper Euphrates, Ravenna, and many other names and families by the name of Bible stories. More than this the city has persisted to modern times. Becoming a Roman colony in the third century it was sacked by Timur the Tartar known as Timur the lame. The Muslima of the plays toward the close of the fourth century and captured by the Turks in 1555. It is now a part of Asiatic Turkey known as Diarbekir. Kar Amida did not do for its output of beautiful mosaic.

In the days of Aetius the city of Amida was subject to Rome. Constantine the Great had declared Christianity the religion of the State and transferred the court to Byzantium. In this very great impetus to growth as the world of Asia Minor and once more this land as it did with ancient history flourished there new importance and that there was of the time and culture. Literature was distributed over that part of the world coming from Constantinople south of the high Asia Minor and thence westward to Alexandria. As the temporal power and its court and religion from the methods of ancient Greece and Rome success came from the same source and led largely of inherited ideas with little added. The Roman Empire was declining and had finally lost its power. A new world domination coming on and under such circumstance the furtherance of scientific matters was of looked upon with great faith by the rulers.

Aetius was a Christian subject of the Emperor Justinian. He studied medicine in Alexandria and after some years became closely connected with the court at Byzantium where he was the personal physician of the Emperor and an officer of the imperial household. A doctor of the great medical men of his time. His work is a compilation of the medical knowledge handed down from the ancient Greeks modified by Celsus and Galen and to a lesser extent

by his immediate predecessors and himself. In it he tries to cover all parts of medicine but does not pay a great deal of attention to surgery. He states however that he has explained some of the surgical work in another treatise but this has never been found. Written in Greek the work was first translated into Latin by Montanus and Cornarius and appeared in 1534. Subsequently the entire work was translated into Latin by Janus Cornarius who was born in Zwicku was professor at Marburg and Jena and is known principally for his Latin translations of the early Greek authors. This volume first appeared published at Basel in 1542 by Frobenius. The Cornarius translation is also included in the *Medicæ Historiæ* of Henricus Stephanus (Henricus Estienne) printed by Huldreich Fugger in 1567.

Aetius entitled his work *The Tetraplōn* the four books. Each of these is divided into four lesser books or sermons thus making sixteen exhaustive books or chapters in all. He refers constantly to the authors from whom he draws and the list is a long one. Surgery he mentions only as a side issue here and there. Little of his treatment is operative but he does refer to ligation and torsion of vessels to stop hemorrhage and describes excision of hemorrhoids. In bites of mad dogs he advises excision of the wound free bleeding and final cauterization. He notes the fear of drinking water among the symptoms and the marked salivation causing foaming at the mouth.

Throughout the entire work the superstitious religious beliefs of the early Christians are evident. Salves and plaster are made to the accompaniment of prayers and incantations and these same elements play a considerable part in therapy. When describing the method of removing a foreign body from the throat Aetius says "As soon as you have gotten the patient quiet and ordered him to listen to you say 'Come out bone' (if it is a bone or call it what you wish) just as Jesus Christ drew Lazarus from the sepulchre and Jonah from the whale then taking hold of the patient's throat say 'Blasphemy the serpent and martyr of Christ command you—either come up or go down'."

Aetius served for us the best of the work of the medical men of the early Christian Era and though not an original thinker like Paul of Aegina nevertheless he played an important rôle in medical history.

♄ AETII MEDICI

GRAECI CONTRACTAE EX VETE-

RIBVS MEDICINÆ TETRABIBLOS, HOC EST QVA-

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quaterniones id est sermones xvi per la-

num Cornarium Medicum Physi-

cum Latine conscripti



FRO REN

BASILEAE M D XLII





and second parts on the ear the nose the accessory sinuses and the nasopharynx have already appeared. A fourth part on the larynx and oesophagus is in the press.

The desire of the authors has been to make the work a practical treatise on the mouth and pharynx—including the hypopharynx. In the surgical technique they have limited themselves to typical operations and to those performed by Professor Moue at Bordeaux. They have included the indications and contraindications as well as the necessary instruments to be employed and due regard is given to complications that may arise. The illustrations are numerous and good.

The descriptions of the various diseases are marked by that brevity and clearness of character typical of French medical writers. To give a typical example one can point to the brief and concise description of septico-phlegmon of the floor of the mouth (Ludvig's angina) which results in a picture one does not easily forget.

This is a volume the laryngologist and general surgeon on will read with pleasure and will keep on hand for future reference. J. G. R. ON WILSON

THE third edition of Eden and Lockyer's *Gynaecology* is well arranged and accompanied by an adequate number of accurate illustrations.

The book is divided into three parts. Part I embraces descriptive anatomy, embryology, disorders of menstruation, tubal pregnancy, and the general subject of infections. This section is especially complete and very well presented. Mechanical disorders in particular are thoroughly discussed.

Part II is devoted to regional gynecology. It includes diseases of the external genitalia, the uterus and the tubes and ovaries. Emphasis is placed on many subjects which are deemed of lesser importance by the modern American school of gynecology, but on which the presentatons are attractive and a curious. More extensive consideration of the subject of endometriosis and less space devoted to endometritis would make a stronger appeal to the American reader.

Part III is devoted entirely to technique. The general principles of uniformly accepted procedures are well presented.

On the whole the text is clearly and concisely written and has been strengthened by revision. It will perhaps make a less strong appeal to the American gynecologist than to his English confreres. ARTHUR H. CURTIS

THE author dedicates his book on *The External Uterus* to his students and explains in the preface that it is an amplification of his lectures

given in the Graduate School of Medicine of the University of Pennsylvania. Certain other useful ophthalmological monographs have originated in a similar manner.

After a critical survey of this work one realizes that the author has succeeded admirably in his endeavor to crystallize and at the same time simplify accepted facts in this perennially difficult and complex chapter of ophthalmic science. The subtitle

A Clinical Study of Normal and Abnormal Ocular Motility is a good designation of the scope of the book. Such a title as The Extrinsic Ocular Muscles rather than The Extraocular Muscles might prove to be more acceptable choice of terms.

The author's ripe judgment on many controversial points regarding the evaluation of certain orthoptic and also surgical measures adds greatly to the interest and value of the treatise.

W. I. MONCRIEF

MACAUSLAND'S *Physical Velocities* is an excellent and useful compendium of all that is known about infantile paralysis and is presented in a concise and interesting form. The history of postepidemics and the probable mode of communication is up to date. The methods of treatment in the various stages of the disease are clearly given in detail. The results of the various forms of mechanical, educational and operative treatment as observed in the author's extensive experience are given without bias and are presented with the judgment of a careful and conservative orthopedic surgeon.

This book can be recommended to all physicians who are interested in the problems connected with anterior poliomyelitis. EDWIN W. RYERSON

PROFESSOR HENRY has given us exact directions for the best exposure of the humerus, radius, femur and ulna in *Exposures of Long Bones and the Surgical Methods*. He ante or method of approach to the femur instead of the customary late exposure is of particular interest. He describes it as respecting anatomy as being relatively bloodless and as giving a wide and convenient exposure. The illustrations make the method admirably clear.

In the latter section of the book the author describes exposure of the plantar structure, a method of ligating the second stage of the vertebral artery, a method of ligating the first stage of the left subclavian artery from behind the cup and ball aneurism needle to deep ligaments, a method of resecting the left cervical ganglion of the sympathetic and innominate trunks for pituitary surgery which is mediated at the pituitary by the X-ray.

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In the words of Sir W. I. deC. Wheeler in the foreword of the book, the author has provided a valuable contribution to the reference library of the scientific surgeon.

FREDERICK CHRISTOPHER

**STLRI NG V MI AN** has written a voluminous book on diseases of the mouth, consisting of 560 pages containing about 300 illustrations. It is a very complete work in that nearly every lesion and malformation occurring in the mouth is given consideration. The arrangement is very formal, synonyms and definitions being given before the discussion of the etiology, symptoms, diagnosis and treatment of each case. For some purposes this is an admirable arrangement, but for the student who wishes a complete knowledge of a specific mouth condition, the text hardly fulfills the requirements. There is much repetition and some of the more important phrases are slighted, especially a clear discussion of treatment.

The views expressed are generally sound and logical, however, and the illustrations are beautifully prepared and nicely supplement the text. An extensive bibliography accompanies each chapter and credit is properly given for all material used. Altogether, the book has been painstakingly prepared and should be a valuable addition to the library of the physician as well as the dentist.

CHARLES W. FREEMAN

In the preface to his short history of surgery,<sup>2</sup> Dr von Brunn calls attention to the paucity of books on the historical aspect of surgery apart from general medicine. He says further that the volumes devoted to surgical history alone are exhaustive treatises designed rather for the specialist in history than for the active clinical surgeon. This condition of affairs has prompted him to produce this work, which is designed to cover the major points in the development of surgery from prehistoric to modern times. The author has done his work well and has accomplished his purpose. Written in not too involved German and with illustrations well chosen, the book gives an excellent survey of the subject without going into too much detail. It will prove a welcomed addition to the library of the clinical surgeon interested in the history of his art.

ALFRED BROWN

**COLE** in his book<sup>3</sup> has presented a convincing exposition of the value of clinical research. The originality of his methods and the weight of his conclusions are stimulating and profitable to the reader.

The author has made a careful study of the function of the parietal peritoneum and of muscular

rigidity. He finds that irritation of the non demonstrative area of the peritoneum does not lead to rigidity, and points out that rigidity of the abdominal wall is not an essential sign of appendicitis.

The chapter on cutaneous hyperesthesia in acute abdominal disease is very interesting. The author found hyperesthesia of greater or less extent in 59 per cent of 185 cases of acute appendicitis. He feels that this symptom can almost always be taken as signifying inflammation or irritation of a viscus or of some part of the peritoneum.

The study of phrenic shoulder pain reaches a conclusion somewhat at variance to that of Capps, namely: There is an important localizing correspondence between the part of the diaphragm irritated and the position of the referred pain on the shoulder.

Irritation of the anterior part of the diaphragm causes pain in the corresponding clavicular or supraclavicular regions; irritation of the posterior part of the diaphragm causes pain in the supraspinous fossa of the same side; irritation of the top of the phrenic dome causes pain in the corresponding acromioclavicular regions; and finally, pain felt over both shoulders indicates a median diaphragmatic irritation.

The differential diagnosis between acute thoracic and acute abdominal lesions is handled most interestingly. A chapter is devoted to the genitourinary symptoms in acute appendicitis. The femoral test for hypogastric peritonitis should

prove of value. The sections devoted to subacute perinephritic abscess occurring without disease of the kidney, and to the extremely interesting subject of extravasation of bile are based upon abundant experience and greatly enhance the merit of the book. The final chapter is a critical examination of the subject of shock and collapse. This small but extremely valuable book should be in the library of every surgeon.

FREDERICK CHRISTOPHER

**THE** translation into English of the fifth edition of Professor Hajek's classical work on the nasal accessory sinuses<sup>4</sup> is sure to receive a warm welcome. The publishers are to be congratulated on giving us a more easily handled and attractive work by issuing the translation in two parts instead of one as in the original. The printing is clear and the reproduction of the illustrations leaves little to be desired.

The introductory chapters on the anatomy of the sinuses have numerous well chosen plates illustrating the important variations. The descriptions are clear and concise and one notes with approval that the author emphasizes that no plates no matter how good can take the place of frontal and sagittal sections of the head. The various sinuses are fully described. The final chapters deal with the complications involving the orbit and visual organs and cerebral complications. The anatomical variations in the sinuses lead the author to the differential

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diagnosis in diseased conditions and the surgical technique which may best be employed. The chapter on symptoms is especially valuable. Here the author has utilized his great clinical experiences extending over so many years. The abundance of the material at his disposal affords ample opportunity to select appropriate cases. There are numerous footnotes of value with brief reviews of recent literature and a valuable bibliography.

The paragraphs on headaches, sinus trouble is characteristically concise. While not in line with the assertion that all cases of nervous and habitual headaches are of nasal origin, the beliefs that a headache should be accepted as serious until a detailed examination of the nose and sinuses has been made. In the chapter dealing with the etiology and pathological anatomy of the maxillary antrum the paragraphs dealing with the relation of the teeth to disease in the antrum are well worthy of note by members of the dental profession.

The translation has been excellent and the English speaking specialist will be glad to hear so authoritatively that his disposal

J. GORDON WILKS

**T**WO volume work on a diagnosis of the stomach and duodenum under the supervision of Dr. Al and other French authors, each of whom is a leader of the specialties of medicine, surgery, and gynecology, is a valuable addition to the bibliography. To the physician who is engaged in the investigation of the digestive tract, these books will have an especial appeal. The value of such a work is that it is demystical, but it is also a guide in half to illustration accompanied by a list of diagrams and a detailed description of a particularly commendable feature because of the author's rare degree in the daily problems of medical and surgical diagnosis. Splendidly illustrated and lucid descriptions make one wish that a English translation were available for the English physician. Attainments do not include the French language. Many of the various pathological conditions which occur in the stomach and duodenum are presented in local divisions.

F. S. BROWN

**W**HILE the title *Manual of Surgery* suggests subjects a par with a long and difficult future, the book like the content of Herter's text covers a materially broader scope than has been found in any similar book. It is especially encouraging.

The first two chapters deal with general material, sutures, ligatures, dressings, bandaging, etc. Chapter 3 on hemorrhage, transfusion and operations of the liver. The chapters on diseases of the lip, tongue, jaws, larynx and injuries of the face and neck are excellently done. The more common conditions of chest and abdominal wall are presented. Then follow

chapters on the spine, anal region and genitalia. The remainder of the book is devoted to the surgery of the extremities including such lesions as burns, sprains, infections of tendon sheaths and bursae. It is quite unusual to see a book so wide a variety of subject ranging from bandaging through numerous special fields of surgery, urology and gynecology so well presented and so excellently illustrated. For the student in the outpatient clinic and the internist it is a very valuable book.

J. R. BUCHHEIMER

**W**HEN one considers the tremendous task involved in sentinizing appropriate illustrations covering the entire subject of surgery under one cover in a volume of a thousand pages or so, the reviewer should be more tempted to commend the good points of the text than partially to criticize the bad for it is generally agreed that we can neither learn nor teach surgery from a text.

Although this book is rather different from most texts on surgery. In the first section under the heading of General Surgery is included inflammation, surgical infection, tumor, injuries, amputations and reconstructive surgery. The second section is devoted to Systemic Surgery covering the circulatory, lymphatic systems, bones, joints and orthopedic surgery. In the third section devoted to Regional Surgery, head, neck, chest and so on down through abdominal surgery and genital are included.

The subject matter is well abreast of current advances in diagnosis and treatment. It is written in a clear, simple, and pleasant style. The illustrations are well chosen and well drawn. In general, this is as satisfactory a book for students of surgery as one could desire.

J. R. BUCHHEIMER

**I**N the fourth edition of *The Art of Anaesthesia* Hagg has endeavored to bring the volume abreast of the day. The drug used and the different methods employed for both local and general anesthesia at the present time are set forth in an organized logical form. This makes the subject clear even to the beginner in anesthesia. Some of the more important points in regard to the open drop method of etherization that cannot be subscribed to by many anesthetists are described. The reviewer is forced to the conclusion that the author has been unfortunate in witnessing the method improperly employed.

The chapter on ethylene is incomplete in that no method of guarding to prevent electrical static sparks from producing explosions is described. The statement that ethylene is not self-igniting in the presence of a flame is contrary to the experience of many competent operators.

The book is a valuable addition to the library of the physician and the student. It is a well written, well illustrated, and well organized work. It is a book that should be read by every physician and student of medicine.

RA. LO. H. G. T. J. D. M. Ed. by F. D. J. Ch. R. H. B. J. P. M. C. T. M. E. Chesky A. B. M. D. F. A. C. S. Lo. Th. C. V. M. by

The great importance of the position of the patient during anaesthesia and the different causes of obstructed breathing are recognized and means for their correction are fully worth reading especially by the inexperienced administrator of anæsthetics.

The chapter on The Point of View of the Patient is well worth the space given to it. To the lack of appreciation of the patient's point of view is due much of the unintentional cruelty too often exhibited in this day of high pressure and hospital routine carried to extremes. The author very correctly states: "In adopting the patient's point of view we eliminate much pain and distress. A moment of thoughtfulness is all that is required. A word, a smile, or a sympathetic glance will do much to lighten anxiety and pain before operation."

This book will be of value to the medical student, interne, and general practitioner and will be read with interest by the specialist in anæsthetics.

ISABELLA C. HERB

ALTHOUGH this book of Alvarez on the mechanics of the digestive tract is termed a second edition it is actually a new book when compared to the first edition. The author discusses thoroughly the mechanical phenomena of the digestive tract from a biological and clinical standpoint in a clear, simple, scientific and interesting manner. Explanations are offered for many of the symptoms observed in gastrointestinal disease to an extent that can be found in no other book. Many of the phenomena are interpreted from the viewpoint of the author's metabolic gradient theory which he fully recognizes is only tentative at the present time. The book includes an excellent bibliography of 900 titles and

frequently at the end of a discussion the reader is referred to monographs which deal in more detail with the subject discussed. The book is not only a valuable contribution to the science of gastroenterology but will be of great value to the student of physiology, the internist and surgeon.

A. C. IRY

PEDIATRICIANS deserve great credit for having called attention to the fact that in illness the child must not be regarded as a little adult, that not only do the pathological pictures differ but that the reaction of the child to pathological changes is often entirely different from the reaction of the adult. The same is true in the so-called surgical diseases. Not only do certain conditions such as acute intussusception or idiopathic hypertrophic pyloric stenosis arise in the child which are not seen in the adult but certain other conditions such as acute appendicitis often show a different symptom complex and run an entirely different course.

In his book on the *Abdominal Surgery of Children* Barrington Ward has emphasized the characteristic features in the etiology, symptomatology and treatment of the surgical conditions of infancy and childhood. He has confined his work to the diseases of the abdomen. In a short, well-illustrated, clearly written little book he has presented the salient features. The book is recommended to those surgeons who do not have the opportunity of observing a large amount of the surgery of children and who will find in this book much that is useful and helpful. Those surgeons who do have a large amount of clinical material among children will find in this book much that is of interest.

PALIN B. BETTMAN

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 I s r a e l B m M D I h l d l p l I A D v s C o m p n y  
 9 8  
 H A N D B O O K O F U R O L O G Y I l l t d b y A v I c h t  
 b g F v l k e I H W l l b l z V l i n d  
 S p i l l U l g i I n d I I B r h J l S p r i n g 9 2 8  
 S U R G I C L A N A T I V B C r a t M a e M B M S  
 ( L o d ) F R C S ( I ) P l i d l p l L e & F b g  
 9 8  
 D I S E A S E S O F T H E C A L L B L A D D E R A N D B I L F D U C T S A  
 B O O F O P R C T I A N A N D S T U D E N T S B y E t  
 A m b G h m A B M D W r H n y C l B S  
 M D G l o v H C p h A B M D n d S h r o o d  
 M o o M D I h l l l p h a L e & I b g 9 8  
 O B S T E T R I C A N U R A T Y T B O K O F T H E N U R S  
 C R E T H E X C A N M o F R F W O M A N A L O R  
 E X U N M O T R A D I B y B y C l y n C t  
 A B l m P A W t h f r w d b y J W h t I  
 W a l l m M D d l N w Y r k T h M m l l  
 C m p y 9 8  
 I S S U E O F O B S T E T R I C S S U B J E C T S B y t h C l s f 9 8  
 S h o o l f M d U i t y f P n y l a a  
 B O D A D U R E C E M I S T R Y B y I B H C d o h l  
 M D d I I E G a l l A B S t L o T h C A  
 M b y C m p n y 9 8  
 L E C T U R E S O F T H E S A N D I A E M O F M E D I C I N E  
 S R I O F 9 7 R E E A A I C H S T R I N  
 R E L A T I O N T M E C I R B y W M K m M  
 o t t B S M D S t L T h C A M b y C m p n y  
 19 8

# CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

GEORGE D STEWART New York *President*

FRANKLIN H MARTIN Chicago *Director General*

## BOSTON COMMITTEE ON ARRANGEMENTS

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CHARLES G MINTER *Secretary*

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NATHANIEL ALLISON  
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J EMMONS BRIGGS  
DAVID CHEEVER  
ARTHUR L CHUTE  
J H CUNNINGHAM  
HARVEY CUSHING  
LINCOLN DAVIS  
HILBERT F DAY  
GEORGE S DERBY  
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A W DUDLEY  
DAVID EDSALL  
JOEL E GOLDTHWAIT  
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OTTO J HERMAN  
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R B OSGOOD  
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CHARLES L SCUDDER  
JOSEPH L STANTON  
A WARREN STEARNS  
JAMES S STONE  
LORING T SWAM  
HAROLD WALKER  
WYMAN WHITEMORE  
HANS ZINSSER

## PRELIMINARY PROGRAM FOR BOSTON CLINICAL CONGRESS

### BOSTON PROGRAM IN BRIEF

#### Monday October 8

- 10 00 Hospital Conference Ballroom Copley Plaza Hotel
- 2 00 Clinics in the hospitals
- 2 00 Hospital Conference Ballroom Copley Plaza Hotel
- 8 15 Presidential Meeting Symphony Hall

#### Tuesday October 9

- 9 00 Clinics in the hospitals
- 2 00 Clinics in the hospital
- 8 15 Scientific session Ballroom Copley Plaza Hotel

#### Wednesday October 10

- 9 00 Clinics in the hospitals
- 2 00 Clinics in the hospital
- 8 30 Boston Surgical Society presentation of Bigelow Medal Ballroom Copley Plaza Hotel

#### Thursday October 11

- 9 00 Clinics in the hospitals
- 00 Clinics in the hospitals
- 2 00 Annual Meeting Ballroom Copley Plaza Hotel
- 3 30 Symposium Treatment of Malignant Diseases by Radium and X-ray Copley Plaza Hotel
- 8 15 Scientific session Ballroom Copley Plaza Hotel

#### Friday October 12

- 9 00 Clinic in the hospital
- 2 00 Clinic in the hospital
- 2 30 Symposium on Traumatic Surgery Ballroom Copley Plaza Hotel
- 8 15 Convocation Symphony Hall

FOR the eighteenth annual Clinical Congress of the American College of Surgeons to be held in Boston from Monday October 8 to Friday October 12 inclusive the surgeons of Boston have planned a highly attractive program of clinics and demonstrations. The program is ample and varied and with increased clinical facilities a record breaking attendance is expected at this year's meeting.

A preliminary program of the clinics and demonstrations as prepared by the Committee on Arrangements is presented in the following pages. During the weeks preceding the meeting these schedules will be revised and amplified so that the final program will completely represent the clinical activities of that great medical center in all departments of surgery. The real program of the Congress will be issued daily. Each afternoon there will be posted at headquarters in the form of bulletins a complete and accurate schedule of the clinics and demonstrations to be given on the succeeding day. Printed programs will be issued each morning.

The subcommittee in charge of the section on surgery of the eye ear nose and throat has prepared in addition to a series of clinics and demonstrations at the hospitals which will occupy the morning hours of each day a series of clinical demonstrations for Tuesday Thursday and Fri

day afternoons to be given in the Georgian Room at the Statler Hotel. A detailed program therefor will be found in the following pages. A special session on Wednesday afternoon will be devoted to a symposium dealing with the standardization of the eye ear nose and throat departments in general hospitals.

General headquarters for the Congress will be established at the Statler Hotel where the ball room, foyer and other large rooms on the mezza nine floor have been reserved and will be used for registration and ticket bureaus, bulletin boards, technical exhibition, executive offices, etc. The ballroom at the Copley Plaza will be utilized for evening meetings, hospital conference, annual meeting and other large gatherings.

An important feature of the general program for this year's meeting will be the showing of several surgical films that have been produced under the supervision of and approved by the American College of Surgeons. A number of films are now complete while others are in course of preparation and will be ready for their premier showing in Boston.

Arrangements have been made for the celebration of Ether Day at the Massachusetts General Hospital Friday forenoon. Exercises beginning at 10 o'clock will be held in the dome room of the old building of the hospital where ether was first administered for the production of surgical anesthesia on October 16, 1846. A bronze bust of William T. G. Morton will be presented to the hospital.

The annual meeting of the Fellows of the College will be held on Thursday afternoon in the ballroom of the Copley Plaza Hotel beginning at

P. M. Reports of officers and standing committees will be presented and officers elected for the ensuing year.

Immediately following the annual meeting there will be presented a symposium dealing with the treatment of malignant diseases with radium and X-ray under the leadership of Dr. Robert B. Greenough of Boston, Chairman of the Committee on the Treatment of Malignant Diseases. A special report on the treatment of cancer of the breast is to be presented.

Friday afternoon's session in the ballroom of the Copley Plaza Hotel will be devoted to a symposium on Traumatic Surgery. Leaders in industry, education and labor together with representatives of indemnity companies and the medical profession will contribute to the discussion. A report will be presented by the Chairman of the Board on Traumatic Surgery as to its activities in the present year. A definite program has been

adopted by the Board and put into effect. The results of the investigations made during the year will be presented.

At the Tuesday evening meeting Sir Squire Sprigge, Editor of the London *Lancet*, will deliver the Hunterian oration. A symposium on the transplantation of ureters with papers by Drs. Charles H. Mayo, Robert C. Coffey, Arthur H. Curtis and others will be a feature of the Tuesday evening meeting.

At a special meeting of the Boston Surgical Society on Wednesday evening at which the visiting surgeons will be guests of that Society, the Bigelow Medal is to be presented to Professor Chevalier Jackson of Philadelphia.

Sir George A. Syme of Melbourne, Australia, president of the Australasian College of Surgeons, will be a guest at this year's Congress. Other distinguished surgeons from abroad who will attend are Professor Archibald Young and Dr. Farquhar Macrae of Glasgow, Scotland; Sir John Lynn Thomas of Llechryd, Wales; and Sir Charles P. B. Clubbe of Sydney, Australia.

#### EVENING MEETINGS

Programs for evening sessions on each of the five days of the Congress are being prepared by the executive committee of the Congress. At the Presidential Meeting in Symphony Hall on Monday evening the president-elect, Dr. Franklin H. Martin of Chicago, will be inaugurated and deliver the annual address. On the same evening Professor Vittorio Putti, professor of orthopedic surgery in the University of Bologna, Italy, and Director of the Pizzoli Institute, will deliver the Murphy Oration on Surgery.

On Tuesday, Wednesday and Thursday evenings the sessions will be held in the ballroom of the Copley Plaza Hotel. The annual Convocation of the College will be held on Friday evening in Symphony Hall at which time the 1928 class of candidates for fellowship in the College will be received. The fellowship address on that occasion is to be delivered by Dr. William J. Mayo.

#### ANNUAL HOSPITAL CONFERENCE

For the eleventh annual Hospital Conference of the American College of Surgeons an interesting series of papers, practical demonstrations and round table conferences that deal with many of the problems relating to hospital efficiency has been prepared and will be found in the following pages. The conference opens at 10 o'clock on Monday morning with a session in the ballroom of the Copley Plaza Hotel. Morning and afternoon sessions in the same room are planned for

the following days. The program has been arranged especially to interest surgeons, hospital superintendents, trustees, nurses and hospital personnel generally, and a cordial invitation is extended to all persons interested in hospital work to attend.

The session on Wednesday afternoon will be of particular interest to those whose practice is limited to surgery of the eye, ear, nose and throat, being devoted to a discussion of the principles involved in the standardization of such special departments in general hospitals.

#### SPECIAL TRAIN FROM CHICAGO

For the convenience of Fellows living in the central and western states who will attend the Boston meeting, arrangements have been made with the New York Central Lines to provide a special train leaving Chicago at 9 A.M. on Sunday, October 7, arriving in Boston at 9 A.M. on Monday. The special train will be equipped with all steel cars of late design, including club compartment, observation, sleeping and dining cars. No extra fare will be charged. The special will arrive at Cleveland at 5:28 P.M., making connections there with regular trains over the Big Four from Indianapolis and Cincinnati. This arrangement is contingent upon reservations for such a special train being made by the minimum number required by the Interstate Commerce Commission rules. Fellows are urged to make their reservations for the special train at the earliest possible date.

#### REDUCED RAILWAY FARES

The railways of the United States and Canada have authorized reduced fares on account of the Boston session of the Clinical Congress, so that the total fare for the round trip will be one and one-half the ordinary first-class one-way fare. To take advantage of the reduced rates, it is necessary to pay the full one-way fare to Boston, procuring from the ticket agent when purchasing the ticket a convention certificate, which certificate is to be deposited at headquarters for the use of a special agent of the railways. Upon presentation of a valid certificate to the ticket agent in Boston, not later than October 16th, a ticket for the return journey by the same route as traveled to Boston may be purchased at one-half the regular one-way fare.

In the eastern, central and southern states and eastern provinces of Canada, tickets may be purchased between October 4th and 10th in the south, western and western states between October 3d and 9th, and in the far western states and western

provinces of Canada between September 30th and October 6th. The return journey from Boston must be begun not later than October 16th.

The reduction in fares does not apply to Pullman fares, nor to excess fares charged for passage on certain trains. Local railroad ticket agents will supply detailed information with regard to rates, routes, etc. Stop-overs on both the going and return journeys may be had within certain limits.

Full fare must be paid from starting point to Boston, and it is essential that a convention certificate be obtained from the agent from whom the ticket is purchased. These certificates are to be signed by the general manager of the Clinical Congress and viséed by a special railroad agent in Boston during the meeting. No reduction in railroad fares can be secured except in compliance with the regulations outlined and within the dates specified. It is important to note that the return trip must be made by the same route as that used to Boston, and that the certificate must be presented during the meeting and return ticket purchased and used not later than October 16th.

An exception to the above arrangement is to be noted in the case of persons traveling from points in the Pacific Coast states and British Columbia who will be able to purchase round-trip summer excursion tickets which will be on sale up to and including September 30th with a final return limit of October 31st. The summer excursion fare is somewhat lower than the convention fare mentioned above, but is available only in the Pacific Coast states and British Columbia. Tickets sold at summer excursion rates permit traveling to Boston via one direct route and returning via another direct route, with liberal stop-over privileges.

#### BOSTON HOTELS AND THEIR RATES

Since the last Clinical Congress in Boston in 1922, a number of new hotels have been built, including the Statler with 1,300 guest rooms, the New Parker and the Ritz Carlton. Some of the older hotels have been enlarged so that there are now ample first-class hotel accommodations in Boston for all who wish to attend the Clinical Congress. Many of these hotels are located within short walking distance of the headquarters hotels.

	M R S Room	M t gl Room	M m w th D bl Room	M m th bl Room
Bellevue 21 Beacon St.	\$4.00			\$7.00
Braemore 464 Commonwealth Ave.	4.00			7.00
Brunswick Boylston and Clarendon Sts.	3.50			5.00
Buckminster 645 Beacon St.	3.00			4.00
Canterbury 14 Ch. Resgate West	4.00			5.00
Charlie gate Charlie gate East	3.00			5.00

	R	M	m	m
	S	I	h	h
	Room	Room	Room	Room
C pl y Pl za Copl y Square	4 00		\$7 5	
Elk 75 T m t St	3 50		5 00	
F n t 534 B on St	4 00		5 00	
G lyn Ch l g t W t	3 00		5 00	
K m e 496 C mm n lth A	3 5		6 00	
Le E ter a d Boyl t St	3 5		4 5	
I l h o Cl l St	4 00		6 00	
N w P rke T m t d Sch l St	3 5		5 5	
P nt 300 Comm w lth A	3 5		5 00	
R t C rit n A l g t n d N l ry St	5 00		8 00	
Sh t n 9 Ba St t R l	5 00		6 00	
S m t 400 C mm w lth A	3 00		5 00	
St tl Pa k S t t A l j t St	3 5		5 50	
T e B y l t d T m t St	5 00		7 5	
V d m Comm we lth n l D tm th	8 00		6 00	
V t r D tm th a d C mm lth	4 00		6 00	
W t m t C pl y Squa	3 00		5 00	
Amer pl				

hospitals and medical schools as to their capacity for accommodating visitors. Under this plan it will be necessary for those who wish to attend to register in advance.

Attendance at clinics and demonstrations will be controlled by means of special clinic tickets which plan has proved an efficient means of providing for the distribution of visiting surgeons among the several clinics and insures against over crowding the number of tickets issued for any clinic being limited to the capacity of the room assigned to that clinic.

#### REGISTRATION FEE

A registration fee of \$5.00 is required of each surgeon attending the annual Clinical Congress such fee providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued which receipt is to be exchanged for a general admission card upon his registration at headquarters. This card which is nontransferable must be presented to secure clinic tickets and admission to the evening meetings.

#### LIMITED ATTENDANCE—ADVANCE REGISTRATION

Attendance at the Boston session will be limited to a number that can be comfortably accommodated at the clinics the limit of attendance being based upon the result of a survey of the amphitheaters operating room and laboratories in the

## PRELIMINARY PROGRAM FOR EVENING MEETINGS

*Presidential Meeting Monday October 8—Symphony Hall 8 15 P M*

Address of Welcome FREDERIC J. COTTON M D Boston Chairman of Committee on Arrangements

Address of Retiring President GEORGE DAVID STEWART M D New York

Introduction of Foreign Guests

Inaugural Address FRANKLIN H. MARTIN M D Chicago

The John B. Murphy Oration in Surgery Malignant Bone Tumors PROFESSOR VITTORIO PUTTI Bologna Italy

*Tuesday October 9—Ballroom Copley Place Hotel 8 15 P M*

Hunterian Oration SIR SQUIRE SPRIGGE M D B Ch F R C S London

Symposium Ureteral Transplantation

ROBERT C. COFFEY M D Portland Oregon Transplantation of Ureters into the Large Bowel

ARTHUR H. CURTIS M D Chicago

CHARLES H. MAYO M D Rochester Minn Contributing Causes of Genito Urinary Anomalies

DISCUSSION GEORGE GILBERT SMITH M D and WILLIAM CARTER QUINBY M D Boston

*Wednesday October 10—Ballroom Copley Place Hotel 8 30 P M*

Special Meeting of the Boston Surgical Society The Presentation of the Henry J. Bigelow Medal to CHEVALIER JACKSON M D Philadelphia

*Thursday October 11—Ballroom Copley Place Hotel 8 15 P M*

PROFESSOR ARCHIBALD YOUNG M B C M F R F P S Glasgow Sacro Coccygeal Chordoma

GEORGE W. HOLMES M D Boston Results of X-ray Treatment in Cases of Cancer of the Breast

SIR CHARLES BALLANCE K C M G C B M V O London The International Cancer Conference British Empire Cancer Campaign

GEORGE W. CRILE M D Cleveland The Adrenal Factor in Hyperthyroidism

COLONEL SIR JOHN LYNN THOMAS K B E C M G C B F R C S Llantridfan Wales Motion pictures on orthopedic subjects with introductory remarks

*Continuation Friday October 12—Symphony Hall 8 15 P M*

Conferring of Honorary Fellowships

Presentation of Candidates for Fellowship

Inaugural Address FRANKLIN H. MARTIN M D Chicago

Fellowship Address WILLIAM J. MAYO M D Rochester Minn

# PRELIMINARY CLINICAL PROGRAM

## GENERAL SURGERY GYNECOLOGY OBSTETRICS UTOLOGY ORTHOPEDICS

### MASSACHUSETTS GENERAL HOSPITAL

*Monday*

Othop d Staff— Dry lnc  
 NATHA TEL ALLISON T b c l of the knee  
 P D WILS N Tub ul of th p n  
 N M SMI t PE s n T b l of th sac o iliac  
 R K GHORM Y Int ald ra g m t fth k  
 NATHANI L ALL N d ARMIN KLEEN C g n tal dis  
 loc ti n of th hip  
 J H MEANS L P KICHARDSON a d G ORGE HOLMES—  
 Thy d lnc  
 Mo ROE McI —3 Ob rv to of b rn  
 P D WH and HOV ARD S RAGUE—33 The h art in  
 g ry  
 G A L AND—4 F l p f h rma  
 Su g n l l bo t i pen f m t 4

*Tuesday*

J D BARNEY R F O N L G G SMI t H H CRA  
 TLEE d F H Co BY—9 G nito rin ry lnc  
 oper t d d mo t t n f c  
 Su g n l Staff— G ral g alop ratio d demo  
 t t f  
 W J MEX J B A ER d J S HODGS N— S g ry  
 fth t m ope t d d m t t  
 D F J s—2 C n fth l d t m  
 L B McKITTER —3 Sp n l x th  
 C A P RTER—33 X burn  
 J V Ml GS—4 Ut n bl d g  
 A W ALLEN d R S THV CK—43 C ul tory d  
 s fth t m t  
 St ff— D mo t t g l l l bo t n  
 D s Yo M o y a d HARTWE —3 C bot  
 Clinic (path logy)

*Wednesday*

S rgn l Staff—9 C l u g l p rat  
 DR KA ANIA — Pl t g ry  
 W y v WHITEM R d DR I RD— Thora c urgery  
 p ato a d d m trat f a  
 R C C BO d Ml CA—2 S al rvc  
 H D L o n d t —3 Syphl i g ry  
 T W H MER—33 T d t  
 W LLIAM H R3 —4 P h try d g ry  
 S rgn l l bo t n p f p c t u f o m t 4

*Thursday*

Oth p d s S rvc—9 Op ratio nd d mo t to of  
 P D W LSON a d MURR y DANFORT A thnt fth  
 p  
 N THANI ALLISON and KE VETH COO SE A thnt of  
 th kn  
 W ROGER d W A STRAMMER A thnt fth hip  
 R K GHORMLEY d HARR LOV l l o m y fti  
 WIL a A Ro RS E d l t d  
 F t S rvc— D m t at f as  
 B VANCE T— S g ry of th pl  
 L P RICH AR SON—3 H n th ugh th c diac  
 fsc f the di phragm  
 St ff— Demon t to ins g l h l bo at nes  
 L D VIS—3 C e fth x m th duodenum and  
 comm n bile d ct.

J M HANFORD (P byt nan H p tal N w Y k) R H  
 MILLER nd W M SIEDDEN—30 Surg l tub  
 culo s c rvi l aden ti  
 E M DALAND—430 Pl tic surg ry

*Friday*

Eth r D y Cel brati n—1 P tat f bu t f  
 D W T C M to byth A sociat d Anre thet t  
 of th Unit d St tes nd C d dth Int rn tio l  
 R rch Soc ty  
 ROB RTH GR ENOL t C C SMI ON s a d ssoc t s—2  
 Tumor cl  
 GEORGE HOLMES and asso iat —3 X ray a d surgery

### HUNTINGTON MEMORIAL HOSPITAL

*Wednesday* Dry cl cs

E M D LAND d G W T VL C ci m fth k  
 C C SMMO s and C C LUND Ca r fth to ruc  
 d b c l m a  
 G A I LAND d J V MEIG C c m fth ce  
 R B GREENOUGH a d C C SMMO Va y gdeg f  
 m l ncy n c nce  
 WILLI t M SHEDDON a d G P HAYDEN C ncer fth  
 ct m  
 E M HER IAN and H V K ANJIAN C ncer fth  
 antrum dac s ry i u

*Thursday* Dry lnc s

W DU E d J C Hc ov Th mod rn X ray pl t  
 E M D LAND d W M SHF d C nc fthelp  
 G G SM th Ca m fth g t ryt ct  
 R B GREENOUGH a d C C SMMO S C c ma fth  
 bre t  
 C C SMMO S M l n nt b t m  
 E M DALAND nd C C LU d Elect c gul tion n the  
 treatment f maligna t d e

### NEW ENGLAND DEACONLSS HOSPITAL

D F JONES a d LELAND McKITTER CA—9 d ly Gene l  
 s g alcl c prt n a d d m tr ton fca  
 T H LAHE H M CLUTE R L M SOVA d L F St  
 —9 daly Ge ls g clcl esp la x thesi  
 thy dc p at a d d m tr t fca  
 D F Jo es d L L d McK TTR CK—2 daly D y  
 l C cer fth l g int tin su gery f  
 d b tcs  
 E P JO LEN F G BRIGHAM H F ROOT PR SCILLA  
 WILTE a d W STANLE CUR IS—3 d ly Tr at  
 m t f the sug cal diabet c d bet a d hyp  
 thy dsm  
 T H LAHEY H M CLUTE a d R L MASON—3 d ly  
 Dry cl c Es phag l d tic l m hart f lu  
 d hyp thy r d m an fth thy d f ci l  
 s tur i h ep thy d  
 SARA M JORDAN—34 daly I d c t f sug y i  
 p p tcul  
 L M HURNTHAL—35 daly C d co d tuo m  
 plet g s gery  
 L B MORRIS—4 daly X y d m strat n d g  
 n i and ther p ss

## PETER BENT BRIGHAM HOSPITAL

*Monday*

- HARVEY CUSHING—2 30 Neurosurgical clinic  
 FRANCIS NEWTON—3 30 Diverticulitis  
 CHANNING CROTHINGHAM—4 Passing of the chronic appendicitis  
 E S EMERY JR—4 30 Study of the results of medical and surgical treatment of peptic ulcer

*Tuesday*

- Staff—9 30 Surgical operations  
 H A CHRISTIAN—2 30 Medical diagnostic and therapeutic clinic  
 GILBERT HORRAX—3 30 Cordotomy for the relief of pain  
 J P O'HARE—4 Hypertension and nephritis in relation to surgery  
 DAVID CHEEVER—4 30 Surgical diagnostic clinic

*Wednesday*

- Staff—9 30 Surgical operations  
 M C SOSMAN—2 30 X-ray study of massive atelectasis of the lung  
 G P GRABFIELD—3 Effect of drugs on the nitrogen metabolism  
 JOHN HOMANS—3 30 Treatment of varicose ulcer  
 S A LEVINE—4 Heart disease in surgery  
 S B WOLBACH—4 30 Demonstration in surgical pathology

*Thursday*

- Staff—9 30 Surgical operations  
 W C QUINBY—2 30 Surgical clinic  
 R H FITZ—3 Insulin in surgical conditions  
 WILLIAM MURPHY and JOHN POWERS—3 30 Treatment of secondary anemia by liver diet  
 HARVEY CUSHING and TRACY PUTNAM—4 Pituitary gland and its influence on growth

## CHILDREN'S HOSPITAL

*Monday*

- R. B. OSGOOD W. E. LADD and associates—Fracture conference combined surgical and orthopedic services

*Tuesday*

- Surgical staff—9 General surgical operations followed by dry clinic  
 WILLIAM E. LADD Hare hip and cleft palate  
 C. G. MIXTER Contractures and plastics  
 H. W. HUDSON Angiomata  
 G. D. CUTLER and KENNETH BLACKFAN Medical aspects of empyema and lung abscess  
 Orthopedic staff—Dry clinic infantile paralysis  
 W. L. AYCOCK and E. H. LUTHER Epidemiology occurrence serum treatment  
 S. M. FITCHER Demonstration of apparatus for prevention of deformity in early cases  
 MISS MERRILL Muscle training  
 FRANK OBER Tendon transplantation  
 E. W. RYERSON (Chicago) and A. T. LEGG Stabilizing operations  
 A. T. LEGG Operations  
 FRANK OBER Moving pictures

*Wednesday*

- W. E. LADD R. B. OSGOOD and associates—9 Combined clinic of surgical and orthopedic services present policies in the treatment of glandular intra abdominal bone and joint tuberculosis

- R. B. OSGOOD W. E. LADD and associates—2 Combined clinic of surgical and orthopedic services osteomyelitis acute chronic circumscribed Brodie's abscess septic joints types of infection and treatment

*Thursday*

- Orthopedic staff—9 Dry clinic  
 ALFRED TAYLOR (New York) and J. W. SEEVER Conference on obstetrical paralysis with lantern slides and moving pictures  
 FREEMAN ALLEN F. SMITH (New York) W. B. CANNON and A. H. BREWSTER Conference on spastic paralysis  
 BRONSON CROTHERS and MISS TRAINOR Muscle training  
 A. H. BREWSTER Stoeffel operation  
 Surgical staff—2 General surgical operations followed by dry clinic  
 C. G. MIXTER Urinary obstruction and infection  
 W. E. LADD Kidney stone  
 THOMAS LANMAN Hernia and undescended testicle  
 C. G. MIXTER and S. B. WOLBACH Kidney tumors pathological aspects

*Friday*

- Surgical staff—9 General surgical operations followed by dry clinic  
 WILLIAM E. LADD Pyloric stenosis  
 G. D. CUTLER Idiopathic peritonitis  
 AUGUSTUS THORNDIKE Appendicitis  
 C. G. MIXTER Intussusception  
 WILLIAM E. LADD Obliteration of bile ducts  
 Orthopedic staff—2 Dry clinic  
 ELLIOTT G. BRACKETT (Cincinnati) and H. J. FITZSIMMONS Conference on torticollis followed by operation  
 F. D. DICKSON (Kansas City) and R. SOUTHER Conference on congenital dislocation of hip followed by closed reduction and shelf operation

## FREE HOSPITAL FOR WOMEN

*Monday*

- W. P. GRAVES and DR. SMITH—2 Dry clinic Gynecological pathology demonstration of specimens and slides

*Tuesday*

- W. P. GRAVES FRANK A. PEMBERTON and R. G. WADSWORTH—9 Gynecological operations Amputation of cervix and caeliotomy (first stage procidentia) perineorrhaphy (second stage procidentia) hysterectomy for fibroid dilatation and curettage caeliotomy for retroversion

*Wednesday*

- W. P. GRAVES FRANK A. PEMBERTON and E. B. SHEEHAN—9 Gynecological operations Plastic and caeliotomy (reconstruction operation) hysterectomy for fibroid dilatation and curettage caeliotomy for retroversion perineorrhaphy for complete laceration of perineum

*Thursday*

- W. P. GRAVES FRANK A. PEMBERTON and DR. SMITH—9 Gynecological operations Amputation of cervix and caeliotomy for procidentia plastic and caeliotomy for prolapse (reconstruction operation) hysterectomy for fibroid closure of vesicovaginal fistula

*Friday*

- W. P. GRAVES FRANK A. PEMBERTON and DR. SMITH—9 Gynecological operations Hysterectomy for cancer dilatation and curettage and application of radium for cancer Dry clinic Demonstration of cancer cases treated



## BOSTON CITY HOSPITAL

M d  
N R M so R M GREEN G T W L F I  
GOOD J P Co E H V H d i J l —  
G m l l a d b t t r l c l o p r t  
and m t t n f e e

T d y  
H B I N T A A R K I P T O H I I H v R D G W P f  
D D SCANNE L S R E R J J H i r v d T W  
W A J A S — 9 S c l l p t l d m  
t a t f

S a l s I a d H I — D y l c  
F W W t — I t p t f t h b l u  
w t h n t t m h f l l v k t t t m  
G C S H T T C A — S a l a p t f m t p l  
m l d

H d d  
H B LOD E J J W L A F R I I H N D I l H  
J C H R D R C C K R D M A  
R v d T K I C H R — S l l c p  
t a d d m t t f  
S c l s I a d — D l  
C R M a d J F W R — U l  
W R M I E R — T h c f t h l d l t  
F B M A L R Y — P t h l l d e m t a t

T l d  
I J C O T T V O J H J H S H L a l W  
M R R o — 9 S g l l p t l d m  
t t n f  
D M R d T R C Y L U — 9 N a l p  
a t  
S g l s r c I A — D y l N e r g l  
S C B d A M Y E S — N l k l l  
B B L — X y d m t t u

F d y  
F B M L R P F B r R F J C r R W  
A r e d t l — 9 C f d p n t a  
t f p c l l j t

## CARNEY HOSPITAL

M d  
A P M c A U S N D — D l T m t n j  
f t h h p j r t l d  
H G L E — D l l t f t h f m l h a f t  
d f t h t b l f l t t l t h p l t  
D I M — D l l l l p t n f  
l m f t h t f d l f t g d o d l  
l w t h p t t f

T d y  
F B L U D A M C K F R A R d a t e — 9 S r l  
p t  
I W J L L P N E L d t — 9 C v  
l d l t l p r t  
A I B E R — I l U t d f t f k o f  
f c t f l p  
I B I D F J D A o d W f B r v E — D y  
l n C h d d n l l  
I W J — D y c l l d l t f l  
t r p t n p t o f u t p l p l t n  
s l d )

H d d y  
D I M W F B o E d a t — 9  
G l b l p t

I W J o v I W P v e u r n d a s o c a t e s — 9 G v n e  
c l l n d b t e t l p t n  
I N J I R S O — D y l c I l a t l e f i s  
t y p s f p t e b p l t n l d g t h m  
b o n g f t r t m t f h o n c a t h t f t h  
p p e a t v e n d n p e r t i e d g  
t n d t m t f d y l l t h e c r  
t o f d f m i t s f t s  
A M C F R E R — D y l c C a e t m y n c u t  
a p p d e t w i t h p t t p r e t a t o f c a  
I E F I t v e — D y l T h l r e r c l c a e  
a r a n t i l a t l d )

T l d  
F B L U D A M C K F R A R d a t e s — 9 G e r a l  
l p r t  
I W J l l P N E L n d a a t s — 9 G y n  
l d l t t l p r t  
W I M A — D y l c M o b l t i o n o f t h e  
k d H  
M H B l r — D y c l S c b d c l b f o o t  
I J D v o — D y l n P t p t m e d c l  
p l l m p p t t r t m a t a d c c  
L F l A E U F — D y l c U t e b l e d l a t r  
l d )

F r d s  
D F M I E W F B R O W N E a n d a s s o c a t s — 9  
G l u k l p t  
F W J l l l l t f r d t — 9 G v  
l a l d b t t r l p t  
A S t a d B A C v — O t h p d c l n  
E J D r — D y l I n t t n l p a t i n  
m t  
W E B R — D y l n F t e s d j r o f  
h d d f m p t t f p l p l t s  
L E I s t r — D y l c A p p d t d p r g  
y

## NEW ENGLAND BAPTIST HOSPITAL

T d y  
E L Y N J R D L J A H B L o d R l d J  
B r r J r — 9 G l s g c l l p r t o  
d d m t t f

H d d y  
F H L A I L Y d H M C L — 9 S r g l p r a t i o n  
S R M J R D d L K E F R — G a t e t l g l  
l c

T l d y  
I l A U N G J D L J c v H B L o e r d d J  
B r r J r — 9 G l u l l p t n s  
d d m t t u f c

## BOSTON LYING-IN HOSPITAL

T d y  
S t f — 9 D y l s  
F H I A L T N H a t l a p n c y  
I S N E F L T m t f p n a c v c o m p l i c t d b v  
h t d a  
S B e n E n d r l t p c l a m p t t a m  
I C I G T m t f p l m p t t a m a b y  
m l f b l d p l m d l f e p c l  
F G C A B R E C l l p t f p y l t i n p g n c y  
G C P R A T I E R T h p t p t m b l d d e r

H d d y  
S t a f f — 9 O b t e t l p t u o s

## HARVARD MEDICAL SCHOOL

*Monday*

- DRS GAMBLE and KEEVER—2 Acid base factors in pyloric and duodenal obstruction in children
- DRS WOLBACH and BLACKFAN—2 Haematological studies with special reference to splenectomy in children
- BRONSON CROTHERS—2 Studies of injuries to the spinal cord in infants
- W L MOSS and DR ELEY— Studies concerning blood transfusion
- LLOYD D FELTON—2 Pneumococcus antibody solution methods and uses
- W LLOYD AYCOCK and E H LUTHER— Infantile paralysis modes of spread use of convalescent serum experiments in immunity and epidemiology of the disease
- M J ROSENAU and H B ANDERVENT—2 Filterable viruses experiments on encephalitis herpes and vaccine virus
- W B CANNON—2 Complete denervation of heart effects of total sympathectomy
- ALEX FORBES and HALLOWELL DAVIS—2 Demonstration in laboratory electrical methods for analyzing functions of nerve tissue
- The new electrophysiology center will be open for inspection to any who are interested in the physiology of the nervous system

*Tuesday*

- DRS GAMBLE and KEEVER— Acid base factors in pyloric and duodenal obstruction in children
- DRS WOLBACH and BLACKFAN—2 Haematological studies with special reference to splenectomy in children
- BRONSON CROTHERS— Studies of injuries to the spinal cord in infants
- W L MOSS and DR ELEY—2 Studies concerning blood transfusion
- L W SMITH—2 Pathology of the thyroid gland
- C L CONNOR—2 The behavior of certain tumors of fowls when transplanted to bone studies in carotid its occurrence its preparation in pure forms results of injection and feeding experiments
- HENRY PINKERTON— The behavior of oils and fats in the lungs the pathology of the splenomegalies in childhood
- SHIELDS WARREN— The prevention of peritoneal adhesions by amniotic fluid experimental and clinical result
- M J SCHLESINGER—2 The effects of haematoporphyrin on animal
- DRS WOLBACH and HOWE—2 The pathology of the deficiency diseases with special reference to scorbutus rachitis and vitamin A deficiency (xerophthalmia)

*Wednesday*

- LLOYD D FELTON—2 Pneumococcus antibody solution methods and uses
- W LLOYD AYCOCK and E H LUTHER— Infantile paralysis modes of spread the use of convalescent serum experiments in immunity and epidemiology of the disease
- J W SCHERESCHESKY—2 Cancer the use of high frequency currents
- M J ROSENAU and H B ANDERVENT—2 Filterable viruses experiments on encephalitis herpes and vaccine virus
- W B CANNON—2 Complete denervation of the heart effects of total sympathectomy
- ALEX FORBES and HALLOWELL DAVIS—2 Demonstration in laboratory electrical methods for analyzing the functions of nerve tissue

- PHILIP DRINKER— New methods of artificial respiration
- CECIL K. DRINKER and STEPHEN WINT—2 New colloid solutions for intravenous injections as substitutes for simple salt solutions
- LOUIS A SHAW— Experiments on the exchange of gases through normal tissues
- STANLEY COBB—2 Microscopic demonstration of capillary injection of the brain
- H S FORBES—2 Demonstration of the cerebral circulation in living cats

*Thursday*

- L W SMITH— Pathology of the thyroid gland
- C L CONNOR— The behavior of certain tumors of fowl when transplanted to bone studies on carotid its occurrence its preparation in pure form results of injection and feeding experiments
- HENRY PINKERTON—2 The behavior of oils and fats in the lungs the pathology of the splenomegalies in childhood
- SHIELDS WARREN—2 Prevention of peritoneal adhesions by amniotic fluid experimental and clinical results
- M J SCHLESINGER—2 The effects of haematoporphyrin on animals
- DRS WOLBACH and HOWE—2 The pathology of the deficiency diseases with special reference to scorbutus rachitis and vitamin A deficiency (xerophthalmia)
- EDWIN J COHN— The interaction between proteins and electrolytes or the more special problem concerned with the nature of the material in liver effective in pernicious anemia
- STANLEY COBB— Microscopic demonstration of capillary injection of the brain
- H S FORBES—2 Demonstration of the cerebral circulation in living cats

*Friday*

Conferences in general surgery orthopedics genito urinary surgery gynecology and obstetrics from 9 to 1

## THORNDIKE MEMORIAL—BOSTON CITY HOSPITAL

*Tuesday and Thursday 2 30*

- GEORGE R MINOT— Treatment of pernicious anemia
- DRS MINOT WEARN and others— Epilepsy capillary circulation achylia gastrica anemia and disorders of the blood cardiovascular diseases metabolism bacteriology
- R P STRONG— Demonstration of certain tumors of parascapular origin
- G C SHATTUCK— Lecture on tropical diseases of surgical interest

## SURGICAL LABORATORY—MASSACHUSETTS GENERAL HOSPITAL

*Tuesday and Thursday*

- M A McIVER— Experimental problems in connection with intestinal obstruction
- J C WILLIAMS— Subject to be announced
- R H SMITHWICK— Circulatory disorders of the extremities

## MASSACHUSETTS GENERAL HOSPITAL

*Wednesday*

- A V BOCK— Studies on the physiology of muscular work in health and disease
- J C AUB— Investigations in calcium metabolism bearing on bone growth and repair
- W O THOMPSON— Studies on thyroid disease and its dosage in exophthalmic goiter thyrotoxic myxedema

C M JONES A d d b et n by t l t m h  
ref f p i n f m t h g t o n t t l t t

## WAPR N IUSCUM

Op d v f t t p p  
D m t t l y D R M C N V A N C t  
D w i g h t l l t l p l l u t r t g l e f m t  
a n h d h  
B n t u m t l v h t n l m u p  
l d a d m p a l l f o m i t S o m  
o f t h p i m n w d t h l t t t h e  
m g r p h f S m d b y t h e A m n  
C l g f S g  
M d l h w s typ f l l f t l f f t f  
p t  
T l p t D N h l l t n l l t t g p t h  
l m l d t f b  
f t e l d l t f l t h y a t d b f  
l n d t r i p l t j d d m y f i g u d  
T b l f l a l j t  
S y p h a l o f b  
D l t n f l f l  
C l l t o f l l g u l t m t b t t l f o e p  
t k v f t t g t t h l b l t l u p p g a d  
l h g t r u m n t

## ROBERT I PIGHAM HOSPITAL

T d  
H A N s — l l f t h c t h t  
g t t t l t d  
L T S — 3 T y p f t h t t h y t d  
a d t h p d p p l t h t a t m t  
H d d v  
P D W s — Op t f k d e f m t  
L T S — 3 D m t t f t h p l a p p t  
T l d v  
L M S E R — C l t d t t h t  
L f B — 3 M h l d t f t h l w b k  
I d  
P D W i l s — O t h p d p t d d m  
t t f t h p d c i p l t l t t  
m t f h t h r t

## CLINICS ON INDUSTRIAL SURGERY

A t t h l t b h l t l f f c f t h M d c l  
D t f t h A m M t l l l l t y I  
C m p v l t h t l l t t d  
t t m t d d l t  
I d  
E R N s A C — S h l d r j  
E v R D L A — 4 I n l p t l t h  
H d d v  
P D W — I t f t h l n j t  
t h k  
R u d J — 4 I d t l d m a t o l g y  
T l d v  
F E J C T T — R t t y d t r y  
J o v D A d s — 4 I j t t h b k  
I d y  
J o n D H o p c s o — F t f t h k l l  
H R R C S — 3 I d t n l n l g y  
H R C M A R B E — 4 H

## MASSACHUSETTS HOMEOPATHIC HOSPITAL

M n d y  
T E C H A N D L E R d H J L E — G l g c l  
c l n Op t s d d m t r a t f e s  
T d y  
C T H O V A R D a d C C R A N E — 9 S u g l p t  
R C W I G G N d S N V O S E — 9 U l g c a l p e t s  
S W L S W O R T H — 9 Y d m t t  
S R M A E R — Gy l g l c l  
J E B r c a d W K S T i o — G e l s u a  
p t n  
H d d y  
F E C I A N D L R d C D H A R E Y — 9 S u g c l p  
t  
A G H o d S L M A R O Y d I G H R D — 9  
O t h p d c p t  
C T H R D d H J L E — S u g c a l o p t  
L f J O H v — B r o c h c p c h c  
T l d y  
J E B r g g n d C C R A N E — 9 S g l p e t  
S R M E G y n c l a l l c  
S W L S W R T H — 9 Y d m t t n  
C T H O W A R a d W K S T t s — S g c l o p  
t

## I d a v

T E C i d l d C C R — 9 S g l p t  
J E B g s I H J L E E — S g l p e t n s

## BOSTON DISPENSARY

T d y  
H J I N G s — L p d l j t n t h d f  
h h t d l b s d n t p t t  
d p a m t  
A R T H U R H C o B I E d H O L D C H A M B E R L A I N — Cy  
t p y d d m n t n f  
J s H H I R A T T — D y l i m p t a c f t h e  
p h y s t o t h g l l t t d b y a  
H d d y  
J O H N D A v s — O t h p d c p t  
H L B E R T F D A Y — l j t t t m t f  
d m t t o f t h q d p a t h  
l g l p c i m  
H R R F R I E D N — D m t t f m l n  
t t d b y d m a d r y t h p y  
T h d y  
A K P A I N E — T m t f g h e w m  
W s A H I N T O N — H t h l t l t  
d m o t t o f t h q d l t b l t y  
M v R D L A D D — S r g a l p c t f p y l c t s  
f t r d

## CAMBRIDGE HOSPITAL

T d y  
S t f — 9 G l g c l l p t a d d m n  
t t f a  
H d d y  
J W S d F A F N D L A — 9 O t h p d l n u c  
p t n d d m o t t f  
F d y  
S t a f f — 9 G l g a l l p a t d d m  
t t n f c

## ST ELIZABETH'S HOSPITAL

## Tuesday

- G F KEENAN—9 Surgical clinic Appendectomy my hysterectomy  
 JOSEPH STANTON—9 Surgical clinic Thru abdominal gastro-enterostomy  
 W F DOLAN—9 Surgical clinic Inguinal hernia  
 C J KICKHAM—9 Prolapse of uterus  
 F T JANTZEN—9 Inguinal hernia under local anesthesia  
 H S ROWEN—9 Appendectomy  
 A L CHUTE and B D WETHERELL—Dry clinic Genito-urinary cases end results and unusual urogenital  
 T J SCANLAN—Gynecological examination  
 PIERCE DUNPHY—2 Cases of cancer of cervix operation and X-ray therapy one to five years after operation  
 PIERCE MCGANN—Postoperative hypospadia

## Wednesday

- F T JANTZEN—9 Surgical clinic Appendectomy cholecystectomy  
 G F KEENAN—9 Surgical clinic Cholecystectomy  
 PIERCE DUNPHY—9 Perineal plastic cancer antineoplastic  
 JOSEPH STANTON—9 Thru abdominal cases  
 R SULLIVAN—9 Knee cartilage  
 T F BRODERICK—9 Reconstruction of hip plastic knee joint  
 T F BRODERICK and R F SULLIVAN—Dry clinic End results in spinal fusion for tuberculosis and anatomical anomalies end results in plastic for relief of deformity  
 F T JANTZEN—2 End results in fractures operative and non-operative colloidal lead treatment for malignant diseases  
 DR HEALEY—Interesting roentgenograms  
 JOHN DUNPHY—Surgical aspects of pediatrics

## Thursday

- T F BRODERICK—9 Surgical clinic Spinal fusion  
 A L CHUTE—9 Prostatectomy tumor of bladder nephrectomy  
 JOSEPH STANTON—9 Gastro-enterostomy cholecystectomy appendectomy  
 H S ROWEN—9 Hysterectomy  
 G F KEENAN—9 Ovarian cyst  
 A H CROSBIE—9 Nephrectomy  
 JOSEPH STANTON—Dry clinic Hurler's syndrome fibroma of colon with intermittent intussusception carcinoma of appendix  
 J J SULLIVAN—Toxemia following administration of alkalies for treatment of duodenal ulcer  
 L J LOUIS—Postoperative pancreatic cyst  
 H S ROWEN—2 Surgical cases

## Friday

- L J LOUIS—9 Surgical clinic Appendectomy cholecystectomy  
 H S ROWEN—9 Cholecystectomy  
 JOSEPH STANTON—9 Appendectomy hysterectomy  
 G F KEENAN—9 Ventral hernia appendectomy  
 C J KICKHAM—9 Cesarean section  
 F T JANTZEN—9 Inguinal hernia under local anesthesia  
 G F KEENAN—2 Dry clinic Postoperative fracture of skull postoperative extension of chest  
 M H SPELLMAN—End results in fractures of skull

## TUFTS COLLEGE MEDICAL SCHOOL

- TIMOTHY LEARY—daily Demonstration of specimens illustrating results of traumatism especially cranial and cerebral

## LONG ISLAND HOSPITAL

## Monday

- J H CUNNINGHAM and C S SWAN—Genito-urinary clinic operations and demonstration of cases  
 CHARLES LUND—2 The use of surgical diathermy in cancer of the tongue and mouth  
 LAWRENCE W SMITH—Surgical pathology  
 H R VIETS—Neurosurgical features pertaining to surgery  
 A B MACMILLAN—Surgical X-ray demonstration

## Wednesday

- ROBERT SOUTTER—2 Orthopedic clinic operations and demonstration of cases traction in the treatment of fractures treatment of congenital hip  
 LAWRENCE SMITH—Surgical pathology  
 H R VIETS—Neurosurgical features pertaining to surgery  
 A B MACMILLAN—Surgical X-ray demonstration  
 CHARLES LUND—Injection treatment of varicose veins operations and demonstration of cases

## Friday

- J H CUNNINGHAM and C S SWAN—Genito-urinary operations  
 ROBERT SOUTTER—2 Orthopedic operations  
 CHARLES LUND—General surgical operations  
 LAWRENCE SMITH—2 Surgical pathology  
 H R VIETS—Neurosurgical features pertaining to surgery  
 A B MACMILLAN—2 Surgical X-ray demonstration

## NEW ENGLAND HOSPITAL FOR WOMEN AND CHILDREN

## Tuesday

- L D ADAMS B L ATWOOD and GRACE ROCHFORD—9 Gynecological operations  
 B L ATWOOD E MACNAUGHTON MARIAN NUTE—9 Cesarean section operative deliveries if available

## Wednesday

- MARIAN NUTE—9 Demonstration of unusual obstetrical cases nursery and ward prenatal clinic  
 L D ADAMS B L ATWOOD and GRACE ROCHFORD—9 Gynecological operations

## Thursday

- GRACE ROCHFORD and OLGA LEARY—9 Demonstration of postoperative cases pathological specimens  
 EVELINE B LYLE and F WRIGHT—9 Demonstration of border line cases

## BETH ISRAEL HOSPITAL

- WYMAN WHITTEMORE and associates—9 daily General surgical clinic  
 F G CRABTREE—9 daily Urological clinic  
 MARK ROGER—9 daily Orthopedic clinic  
 HERMAN BLUMGARD—Demonstration in medical research department

BOSTON UNIVERSITY SCHOOL OF MEDICINE  
(Evans Memorial Building.)

- S R MEAKER and A W ROWE—2 Wednesday and Friday Studies in sterility  
 A W ROWE and C H LAWRENCE—Wednesday and Friday Endocrinology

## SURGERY OF THE EYE EAR NOSE AND THROAT

## CLINICAL DEMONSTRATIONS

*Tuesday P.M.—Georgetown Station Hotel*

J M WHEELER MD New York and GEORGE S DERBY MD Boston Ophthalmologist  
 C B FAUNCE MD Boston Br Abscesses Lipiodol Injections in Br in Abs  
 H I CAHILL MD Boston Report of a Case of Cerebral Abscess  
 D C SMYTH MD Boston Lipodermatoma in Lung Abscess  
 E W HERMAN MD Boston Various Cases of Foreign Body in the Tracheo Esophagus

*Wednesday P.M.—Georgetown Station Hotel*

Intention of the Medical Association with minimum requirements for general hospital  
 nursing hospital general training hospital patients Standard program under Hospital  
 Conference

*Thursday P.M.—Georgetown Station Hotel*

D H WALKER MD Boston Lip Radical of the Dental Child Aid to Hospital  
 C D K WITMAN MD Boston Amal Stitches in the Rectum of the Ventricle Muscular  
 L A SHAW MD Boston Microscopic slides illustrating pathological condition of the  
 D W DREW MD Boston Treatment of Metastatic Carcinoma of the  
 T B HILLMAN MD Philadelphia Ophthalmic Relations at the Base of the Skull  
 F H VERHOEFF MD Boston Ophthalmic Pathology

*Friday P.M.—Georgetown Station Hotel*

J H WAITE MD Boston Diagnosis of Glaucoma  
 W B LANCASTER MD Boston Ophthalmic Microscopy  
 A GREENWOOD MD Boston Hospital for Strabismic Glaucoma  
 H I CAHILL MD Boston Lanthanum slides illustrating various forms of  
 F I GARLAND MD Boston Infantile Submaxillary Gland Disease of the  
 A H KAZAJIAN MD Boston Otitis with the Tip of the Nose  
 H I MESHER MD Boston Report of a Case of Carcinoma of the Submaxillary Gland  
 of the Tongue (Microscopic Pathology)

## MASSACHUSETTS EYE AND EAR INFIRMARY

*Tuesday*

Ophthalmic

Staff—Ophthalmic  
 J M WHEELER MD  
 G S DREW MD  
 W H ILLMAN MD  
 J H WALKER MD  
 L B DREW MD  
 P C C. P.  
 H I MESSER MD  
 I A C. DREW MD  
 T I T. DREW MD  
 I L K. DREW MD

Otolaryngic

P R. DREW MD—Simplification of the dental procedure  
 H A B. DREW MD—Medical treatment of the  
 H I C. DREW MD—Dental work of the  
 P. DREW MD—After the dental treatment  
 G H T. DREW MD—Lithotomy

C B F. DREW MD—Dental procedure

D C S. DREW MD—Dental procedure

Otolaryngic

G H P. DREW MD—Otolaryngic  
 F A S. DREW MD—Medical treatment of the  
 G H P. DREW MD—Surgical treatment of the  
 H I C. DREW MD—Medical treatment of the  
 P I M. DREW MD—Medical treatment of the  
 A S M. DREW MD—Dental procedure

Ophthalmic

Staff—Ophthalmic  
 W B L. DREW MD  
 J B A. DREW MD  
 M. DREW MD  
 J H W. DREW MD  
 I A C. DREW MD  
 B S C. DREW MD  
 H K M. DREW MD  
 P A C. DREW MD  
 T I T. DREW MD  
 D A C. DREW MD

## Thursday

## Otolaryngology

- V H KAZANJIAN—9 Plastic operations  
 D C SMYTH—9 Dry clinic Fluoroscope and removal of metallic foreign bodies  
 H P MOSHER—10 Dry clinic Exhibition of cesophagi in instruments demonstration of fluoroscopic ministration of the cesophagus  
 A S MACMILLAN—11 Dry clinic Lantern slide demonstration of cesophageal cases  
 Dr J H BY— Demonstration of Barany test  
 I F GARLAND—3 Dry clinic Infection of the submaxillary gland

## Ophthalmology

- Staff—9 Operations and demonstrations of cases  
 F B HOLLOWAY—Thyroid cases  
 A GELFAND—Lase operations  
 S J BEACH—Refraction with angular type  
 W B LANCASTER—Muscles  
 H B C RIEMER—External diseases  
 F B DUNPHY—Perimetry  
 H K MESSENGER—Physiology of optics  
 P A CHANDLER—Light sense  
 T I TERRY—Pathology  
 Ida E RIDGEWAY—Sight saving class

## Friday

## Ophthalmology

- Staff—9 Operations and demonstrations of cases  
 I H VERHOEFF—Lase operations  
 H B C RIEMER—Tear sac cases congenital acute chronic  
 Amy SMITH—Social work  
 I H K MESSENGER—Physiology of optics  
 P A CHANDLER—Light sense  
 T I TERRY—Pathology  
 Ida E RIDGEWAY—Sight saving class

## Otolaryngology

- V H KAZANJIAN—9 Dry clinic Correction of deformities of the face and nose lantern slide demonstration  
 H P MOSHER—10 Dry clinic Functional cheilomy  
 A S MACMILLAN—Larynx of thymus (lantern slides)  
 I L GARLAND—11 Historical exhibit of laryngeal instruments  
 H P CHILL—2 Dry clinic Lantern slide demonstration of serial sections of the ear  
 D H WALKER—3 Dry clinic Lip reading and the deaf child

## CARNEY HOSPITAL

## Tuesday

- W S LIEBMAN—9 Lase operations and demonstration of cases Laryngeal localization and maxillary traction of foreign bodies

## Wednesday

- F D HURLEY and W S LIEBMAN—9 Eye operations and demonstration of cases

## Thursday

- W S LIEBMAN and H BORNCHOFF—9 Eye operations and demonstration of cases

## Friday

- W J SILEMAN and I G MITTER—Otolaryngology and cal clinic

## MASSACHUSETTS HOMOEOPATHIC HOSPITAL

## Tuesday

- W D ROWLAND—9 Eye clinic  
 F W COLBURN and H I BABCOCK—9 Aural clinic

## Thursday

- W D ROWLAND—9 Eye clinic  
 C SMITH C W BUSH I P JOHNSON P O PARRI and W W WALKER—9 Nose and throat clinic

## Friday

- W D ROWLAND J F STERNBERG H M EMERY and J J SHIPBALL—9 Eye clinic

## HARVARD MEDICAL SCHOOL

## Monday

- H P MOSHER—Laryngological demonstration Cast of the adult cesophagus wet specimen showing the cesophagus at birth cadaver demonstration of the Mosher Trolachrymal sac operation teaching methods used in postgraduate instruction in laryngology

## Tuesday

- G S DERBY—Ophthalmological demonstrations Active earle demonstrations of what the pathological laboratory is doing and has done in the past demonstration of work on the light sense teaching of physiology of optics

- Drs VERHOEFF and TERRY—Demonstration of pathological slides

- Drs DERBY CHANDLER and MISS O BRIEN—Significance of the light sense and a demonstration of the method by which it may be tested

- LUCIEN HOWE—Ophthalmic emicograph writes automatically the story of ocular fatigue and relation of this fatigue to eye strain

- H P MOSHER—2 Mosher Trolachrymal sac operation demonstration on cadaver

- P F MELTZER—Anatomical exhibit of temporal bone specimens

## Wednesday

- H P MOSHER—Laryngological demonstration Casts of the adult cesophagus wet specimens showing the cesophagus at birth cadaver demonstration of the Mosher Trolachrymal sac operation teaching methods used in postgraduate instruction in laryngology  
 C B FOUNCE—Exhibition of temporal bone specimen

## Thursday

- G S DERBY—Ophthalmological demonstrations Active earle demonstrations of what the pathological laboratory is doing and has done in the past demonstration of work on the light sense teaching of physiology of optics

- Drs VERHOEFF and TERRY—Demonstration of pathological slides

- Drs DERBY CHANDLER and MISS O BRIEN—Significance of the light sense and a demonstration of the method by which it may be tested

- LUCIEN HOWE—2 Ophthalmic emicograph writes automatically the story of ocular fatigue and relation of this fatigue to eye strain

- H P MOSHER—2 Demonstration of method in postgraduate teaching of laryngology

- M H LURIE—3 Exhibition of temporal bone specimens

## BOSTON DISPENSARY

T e d y

H J INGLIS—2 Beck Schenk snare meth d f t s l  
l ct my

W d day

JOSEPH J SAIR ALL—1 Ey l c d m t t n f  
c extern l d ea p rim try phth lm l g c l  
co-operat n with syph l cl

## ST ELIZABETH'S HOSPITAL

T d y

W T HALEY—9 Masto d d t l es

W d d

P S McADAMS—9 Enucl t f th y  
J BURNS—9 T llect my

F d y

W T HALEY—9 F tal op t

J BURNS—9 M t d p at

W T HALEY—E d lt d l p t

## CAMBRIDGE HOSPITAL

N S BACOV and E J BUTLER—9 Th rsday Nose a d  
th t cli cNEW ENGLAND HOSPITAL FOR WOMEN  
AND CHILDRENM N KLEINERT and I D KERR—9 T esd ya d Wed  
d y l n nd th at cln op ti s d  
d m t at n f ca s

## BETH ISRAEL HOSPITAL

L V I HEDMAN and L ARKIN—9 da ly No e d th t  
l

## BOSTON CITY HOSPITAL

J J CORBETT—9 d ly Fy l nic

## CARVER HOSPITAL

I D HURLEY—9 d ly l y cl

## ANNUAL HOSPITAL STANDARDIZATION CONFERENCE

*Monday 10 00—Ballroom Copley Plaza Hotel*

- GEORGE D STEWART M D New York Presiding  
Address of Welcome FREDERIC A WASHBURN M D  
Boston Director Massachusetts General Hospital  
The Role of the American College of Surgeons in Improving  
Hospital Service GEORGE D STEWART M D New  
York President American College of Surgeons  
Presentation of Annual Report of Hospital Standardiza-  
tion and Announcement of Approved List for 1928  
M T MAC EACHERN M D Chicago Associate  
Director American College of Surgeons and Director  
of Hospital Activities  
Health Inventoriums in Approved Hospitals—Further  
Progress of Research FRANKLIN H MARTIN M D  
Chicago Director General American College of Sur-  
geons  
The Interest and Influence of the Duke Endowment in  
Hospital Standardization W S RANKIN M D  
Charlotte N C Director The Duke Endowment  
Nurses Patients and Pocketbooks MAY AYRES BURGESS  
Ph D New York Director Committee on the Grad-  
ing of Nursing Schools  
General Discussion WILLIAM DARRACH M D New York  
Dean College of Physicians and Surgeons Columbia  
University and MARY M ROBERTS R N New York  
Editor American Journal of Nursing

*Monday 00—Ballroom Copley Plaza Hotel*

- GEORGE D STEWART M D New York Presiding  
Missed Pedagogic Opportunities Incident to the Usual  
Organization of the Resident Medical Staff of the  
Hospital HENRY A CHRISTIAN M D Boston  
Hersey Professor Theory and Practice of Physic  
Harvard University Medical School  
Medical Education and Specialization WILLARD C  
RAPLEY M D New Haven Director of Study  
Commission on Medical Education  
Experimental Science versus Imitative Art in Medicine  
MURRAY BLAIR M D Vancouver B C  
What Is the Role of the Hospital Administrator? F E  
CHAPMAN Cleveland Director Mt Sinai Hospital  
Visual Methods in Conducting the Staff Conference (Illus-  
trated) C G PARVALL M D Rochester N Y  
Director Rochester General Hospital President elect  
American Hospital Association and HARRY D  
CLOUGH M D Rochester N Y Assistant Medical  
Director Rochester General Hospital  
General Discussion CHARLES H YOUNG M D Portland  
Maine Director Maine General Hospital and JOHN  
T BURRUS M D High Point N C Surgeon High  
Point Hospital

*Tuesday 9 30—Ballroom Copley Plaza Hotel*

- JOSEPH B HOWLAND M D Boston Superintendent  
Peter Bent Brigham Hospital Presiding  
The Educational and Economic Value of the Outpatient  
Department in a General Hospital JAMES RAGLAN  
MILLER M D Hartford Assistant Gynecologist and  
Obstetrician Hartford Hospital  
Select a Economic Basis for Outpatient Service (Illus-  
trated) BEATRICE KAISER Detroit Clinic Executive  
Harper Hospital  
Minimum Standards for the Hospital Social Service De-  
partment MABEL R WILSON R N Boston Director  
Social Service Department Children's Hospital

- The Operation of a Physical Therapy Department from the  
Scientific and Economic Standpoints JOHN S  
COULTER M D Chicago Assistant Professor of  
Physical Therapy Northwestern University Medical  
School  
Discussion MICHAEL M DAVIS Ph D New York  
Executive Secretary Committee on Dispensary De-  
velopment United Hospital Fund of New York and  
FRANK GRANGER M D Boston Director of Physical  
Therapy Department Boston City Hospital

*Tuesday 00—Ballroom Copley Plaza Hotel*

- Clinic on Case Records in Hospital Directed by C W  
MUNGER M D Valhalla N Y Director Grasslands  
Hospital  
What Constitutes a Good Case Record? ERNEST LEROI  
HUNT M D Worcester Surgeon and Director of  
Surgical Services Worcester City Hospital  
What Are the Best Methods of Appraising Case Records?  
HAROLD W HERSEY M D Bridgeport Superin-  
tendent Bridgeport Hospital  
What Part Should the Record Librarian Play in Promoting  
Efficient Case Records in the Hospital? GRACE W  
MYERS Boston Librarian Emeritus Massachusetts  
General Hospital  
How Best Can Good Case Records Be Maintained in the  
Small Hospital Where the Usual Difficulties—Lack  
of Internes Shortage of Funds and No Historian or  
Record Librarian—Are Frequently Found? CLARA  
A DOOLITTLE Derby Conn Historian Griffin  
Hospital and President Connecticut Hospital His-  
torians Association  
What Are the Most Effective Ways and Means of Stimulat-  
ing Good Case Record? EMMA C BLACK New Haven  
Record Librarian Grace Hospital  
What Should Be the Functions of a Record Committee of  
the Medical Staff? E W WILLIAMSON M D  
Chicago Chief Field Representative American  
College of Surgeons  
What Are the Most Effective Means of Keeping Current  
Case Records up to Date? R C BUECKI M D  
Madison Superintendent Wisconsin General Hospital  
What Are the Relative Advantages or Disadvantages of the  
Various Filing Systems? EDITH M ROBBINS Boston  
Chief Record Librarian Peter Bent Brigham Hospital  
The Organization and Functioning of a Central Record  
Department GENEVIEVE CHASE Boston Record  
Librarian Massachusetts General Hospital

*Wednesday 9 30—Ballroom Copley Plaza Hotel*

- Open Forum—Problems Involved in the Practical Care  
of the Patient Directed by LEWIS A SEXTON M D  
Hartford Superintendent Hartford Hospital  
Measuring the Practical Efficiency of the Hospital  
JOSEPH C DOANE M D Philadelphia Superintendent  
Philadelphia General Hospital  
Standard of Surgical Efficiency GEORGE W SWIFT M D  
Seattle Surgeon Children's Orthopedic and King  
County Hospitals  
Medical Staff Organization T T MURRAY Albany  
Superintendent Memorial Hospital  
Relation of the Clinical Pathologist to the Medical Staff  
and the Scientific Work of the Hospital J J MOORE  
M D Chicago Director National Pathological Laboratory



Pespo bly f H pital Tru te s f the P f l  
C f the P t JOSEPH J WE ER N w Ha n  
Sup rint d t G e H pital  
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F t n th H p t l J n E RAN om T l d  
S p t n d t T led H p t a l

H d d y oo—G g R om Sl ller Hohl

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m l l Rh l l d O t La yn l b l  
lat t J n C B MD Ch A t  
f f f O t L r y l y U s ty f Ill s  
C ll f M d

D R RT C l n c i MD N w O l n  
I f f O t L y l y T l n U ty f  
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I u d T b l C f Ophth l m l P l h g l d  
t th C f Ophth l m l P l h g l d  
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I l v f M l

Sh d d All f t I P t l Exp  
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MD T l d Ophth al m l t d Ch i f St f l  
H p t l

H C l u t A e s t h S B M t d  
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MD H m l t O t n A t S r g e o H m l t  
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f th U l N d Th at D p t m t B

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D p a t m t ? S H E P S W R E W M D B o t n  
I th l g t N e w E l n d D c e s H p t l

H d d y oo—B l l o C p l v P l H t l

Op n F r u m—The S m l l H p t l n d H p t l St d  
a d t n D t d by P u l F E S L E R M a n c a p l  
S p e t n d t U ty H p t a l  
Wh t th D k L d w m t l s D g f r th S m H  
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T l d a 9 3 0—B l l C p l y P l a H t l

F U L L E R F B R E S B t l C P s d t B a d f  
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W k e g M l l f I S u r g y N t h w e t  
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n f W t t H p t a l A R N O L D H K E G E L M D  
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## H d d v oo—G g P St Her II kl

G RCE S D r MD B t I f f Opl th l  
 m l y H d l t v M l l s h l l l ng  
 I t t n f M l D l th M m m R q  
 m t f G l H p t l C g f Ophth l  
 m l l Rh l l d O t l v n l g l  
 l t t J H C B MD Ch A t  
 I f f O t l y l y U ty f Ill  
 C l l f M d  
 D R t C l c r MD N O l  
 I f f O t L y l y l l U ty f  
 L l t C d t s h l f Med  
 P D Tbl c f l y D l f l l m P l t d  
 t th C f Ophth l m l f I h l l d  
 O t L y l l f t t C l H p t l  
 D t d b y l l G l l MD T t  
 I f f O t l y l y l y U r s ty f T t  
 I l ty f M d  
 Sl l l l l t R P t l Exp th  
 I y E N d T l t D p tm t r H r c f  
 W r MD T m W l S g G l  
 H t l l  
 Sh l l l l St d t N R I t l l x p n  
 th I L N d Th t D p tm t r H S  
 t W l E t t G L A t N T y N A  
 Sp t d t S t H p t l  
 I It l l bl d l t l St l d i z R t P  
 d l l D d S p p l l t  
 t th W k f t l Sp l t ? W t r e H S  
 MD T l l f Ophth l m l t d Ch f f St ff  
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 H C l l l t l A r th S B M t l  
 f th J y l N d Th t D p tm t r  
 F r i n A MD B t A a th t t  
 M h t l l y d l l n m  
 I th Ab f th Att l D t d Wh Th  
 I N l t l d t Wh t F m A y M  
 C th H p t l l l l C t C f  
 H m l f l l f W l A m th A  
 d t Wh h M h t l l l th W k f t l Sp  
 l t J O M K d MD D l l a Oph  
 t l m l A l S St l l S t a m  
 H w l th A A Sh l d T l C B th  
 H p t l l l l t l f ? Sh l d M l C f  
 D h l l l f U k O B  
 S l t l f m O t l t t W t c A r c l  
 MD H l l O t A t S geo H m l t n  
 C l l l l l  
 Wh B l l H p t l Sh l d th Op t g P m  
 f th l L N d T l t D p tm t B

L c t d n th C n l S g r y S t n th D  
 pa tm t w th the W d ? DAW H BALLOU M D  
 M nt l D m n t t n O t Laryng l gy McGill  
 Un e ty f Cult y f Med c  
 What l e Lab t y l a m i n a t o Sh l l B R  
 q d n th W k f th l y L a N e d Th t  
 D p tm t ? S t s W A R E N MD B t  
 Path log t N w E gl d d c n H p t l

## Hed d y o—Ball C pl y Pl a H l l

Op F rum—Th Sm l l H p t l d H p t l Sta d  
 d z at D c t l b y P u l F e s t r M n n a p l  
 Sp t d t d Un ty H p t l  
 What th D ke E d v m t I D n g f r th Sm l l  
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 H p t l  
 H w th M d c l St f f d l Small H p t l C n Be  
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 R r MD Ch l t t N C D c t r th  
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## Tl d 9 30—B l l C pl y Pl Hot l

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 Th C f th C l c n t P t n t J o n n B r y n r  
 MD B t  
 Th R p c b l ty f t l H p t l A l m n t t n n th  
 C f l t C R l l S c l p MD B  
 C l t s S s Ma h u t s C n l  
 H p t l  
 Th P p l l ty f t l e H p t l A d m t a t n th  
 C r f th J u d F r c A B e l e MD  
 W k r H l l f r f S g r y N th w e s t m  
 U t y M d l s h l  
 P b l ty f P t p a r t I n f t from C n t m  
 f W t r H p t l A r o l d H K E G L M D  
 Comm f H l l C t y f Ch g  
 B ty t l H p t l R E C B M L Y E R S J  
 M l k L c t u e D t r C a t l l c H p t l  
 A c t n n



# LUKENS PICTORIAL TECHNIQUE

## BONE AND JOINT SERIES

### F. ARTHRO L ST OF JAW



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St I

# SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE PUBLISHED MONTHLY

VOLUME XLVII

OCTOBER 1928

NUMBER 4

## THE ETIOLOGY OF PULMONARY ABSCESS<sup>1</sup>

By MINAS JOANNIDES M D CHICAGO

F m th D p tm t f S g ry U ty of Ill is C ll g f M d

**P**ULMONARY abscess may be defined as a localized necrosis and liquefaction within the parenchyma of the lung due to infection. This suppuration may have its origin either in the lung parenchyma in the bronchial tree or by extension from an adjacent suppurative process. The abscess may be associated with or may be the result of pneumonia and other diseases of the lung; it may be secondary to aspiration of infected materials into the lung or it may be the result of infarct secondary to infected pulmonary embolus. It may result also from injuries to the chest and intrathoracic organs from blunt trauma, bullet wounds, stab wounds or from an extension of infection through the diaphragm.

### HISTORICAL

Our earliest written records of pulmonary abscess are to be found in the works of Hippocrates (17) who recognized abscess of the lung as such and considered aspiration of blood and mucus as the cause of the disease. He taught that a pulmonary abscess that had burst into the pleural cavity could be healed by draining the latter and to that end he described a method of thoracotomy. From the time of Hippocrates in the fourth century B C no written records appeared on pulmonary suppuration until 1584 A D when Schenk (38) called attention to this condition. He is credited with a case in which he promoted spon-

taneous rupture by fomentations. Baglivi (3) in 1696 is said to have established drainage by intercostal incision. Other early workers in this field were Barry, Campardon, Sharpe and Pouteau. In 1793 Gumprecht (12) published a monograph on the diagnosis, prognosis and treatment of pulmonary abscess. He states that before surgical treatment is instituted it is necessary to determine the presence and seat of pus and the condition of the pleura as to adhesions.

J B Murphy (28) classifies the various etiological factors under 9 separate headings as follows: (1) acute circumscribed inflammation as pneumonia followed by necrosis and softening of the lung (46 per cent); (2) peri-bronchitis; (3) septic embolism of the pulmonary artery or a single branch of the bronchial; (4) rapid tuberculous caseation and necrosis with secondary infection; (5) perforation of the lung by infection from malignant diseases of the oesophagus and mediastinum; (6) subphrenic perforations into the lung with retention; (7) foreign bodies in the bronchi; (8) infections following injuries; and (9) suppurative inflammation around calcareous deposits, the latter either a sequence or a cause of the suppuration. In his classification Murphy makes no mention of aspiration of infected material other than foreign bodies. More recent studies bear out the original Hippocratic theory that aspiration of infected blood is of great importance as a cause of abscess.



I b D g z (3 Impl t t f t d p t  
A u t o I h m l k l l d S i t m l o  
9

Clayton (5) in 1916 reported 4 cases with recovery. In a study of 7 cases Lord (6) found that in 78 cases the etiological factor was an operation about the upper respiratory tract and in 49 per cent of these cases the operation was a tonsillectomy. On the basis of the statistics he stated. On the whole the impression is that ingress of infected material from above into the deeper parts is regarded as the chief cause of pulmonary abscesses.

Hedblom (1) states. Aspiration of infected material appears to be a more frequent cause of abscess than generally recognized. Of considerable interest and importance are the apparently relatively frequent lung abscesses following tonsillectomy.

Lemon (4) carried out a series of experiments to study 4 different factors relative to pulmonary aspiration namely (1) to learn whether or not aspiration does occur when the animal is anesthetized (2) to discover some of the factors necessary to permit aspiration (3) to evaluate the accidents that may occur during anesthesia and their relationship to aspiration and (4) to learn the result of either anesthesia on some of the recognized protective mechanisms of the lung. The results of his experiments are as follows (1) when the dog under anesthesia lies on a plane inclined at various degrees aspiration occurs regard-

less of whether the anesthesia is light or deep. No aspiration occurred in non-anesthetized dogs. (2) The position of the head relative to the body seems to make little if any difference in the amount of material aspirated. (3) When there is a relatively large amount of fluid material aspiration by suction pump fails to prevent the downward course into the lung. (4) In almost every instance the fluid preceded the particulate matter. (5) When the head of the animal was 28.75 centimeters lower than the feet aspiration did not occur.

In the discussion of Lemon's paper Hedblom (14) called attention to the fact that pulmonary infection in man following aspiration must depend largely upon the nature or the virulence of the infective organisms or both. This experimental work he continues.

certainly seems significant in supporting the view that most of the cases of pulmonary suppuration that follow nose and throat operations are due to aspiration of infected material. At that time the hope was expressed by Hedblom that investigations be pursued in the direction of determining the role that different types of infection may play in the production of pulmonary lesions.

Myerson (9) in a bronchoscopic study of 100 cases undergoing tonsillectomy under light general anesthesia found that the abolition of the cough reflex is of great importance in aspiration. In 76 cases the cough reflex was abolished and in 7 of the cases he noticed blood and mucus below the larynx. In 2 out of the 100 cases the cough reflex was not abolished. In only 4 of this number did he notice blood and mucus below the larynx. We agree with Myerson (30) that the failure to expel aspirated material is more important than the aspiration itself. By keeping this factor in mind and causing the infected blood to be entrapped in the alveoli we were able to produce abscesses in over 70 per cent of our dogs.

That the aspirated blood reaches the alveoli very readily is proved also by the work of Corper (6). He observed that under ether anesthesia aspiration of fluids after instillation into the nose occurred readily in dogs and rabbits placed in the horizontal position. In the non-anesthetized animal lying in a horizontal position however repeated manual

instillations did not cause aspiration. On the other hand with the non anesthetized animals in the vertical posture the aspiration of fluids was easily attained in rabbits but less so in dogs the fluid being found mainly in the lower lobes. Corper also found that particulate matter such as carbon particles are found heaped up at the points of bifurcation of the air passages with relatively little being retained in the alveoli. In another series of experiments he traced the aspirated fresh blood to the alveoli of rabbits as late as 4 weeks after the intratracheal injection. At the site of the blood localization the presence of a distinctly palpable induration was noticed. This was due to a proliferative pneumonitis occasioned by the presence of blood in the finer pulmonary subdivisions. This induration was found to persist longer than 4 weeks.

Herb (16) made an extensive study of the effects of anesthesia on the lungs. She states that ordinarily ether is not any more likely to produce lung complications than a local anesthetic especially if the ether is administered properly. She condemns the use of the closed mask and quotes the work of Dresser (11) who found that the ether vapor within the closed mask sometimes reached a concentration as high as 34 per cent while 6 or 7 per cent is the strongest concentration which may be inhaled without irritation to the air passages. In addition to aspiration other factors important in the production of lung complications are weak heart action low blood pressure generalized sepsis cooling of the body surface diminished lung expansion caused by pain or tight bandages and morphia which reduces the cough reflex.

#### FUSOSPIROCHAETAE AND PULMONARY ABSCESS

The most fruitful research in pulmonary abscess has been the study of fusospirochaetæ. As early as 1866 Leyden and Jaffe (5) were inclined to incriminate a variety of the leptothrix as the cause of pulmonary suppuration. In 1898 Withington (42) expressed his belief that bacteria may play a part in abscess formation. He quotes Babes ( ) as saying

The saprophytes cannot of themselves produce gangrene but are inevitably associated

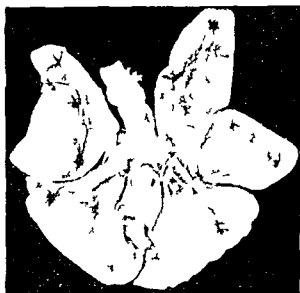


Fig. 1. Dog 10 days after implantation of lean and shadow at site of implantation.

with some other organism generally the pyogenic coccus. Thus in 12 cases he found the association to be with staphylococcus in 1 with streptococcus and in 3 an extremely virulent pneumococcus. Indeed all these cocci showed remarkable virulence. But these of themselves could only effect suppuration or necrobiosis while upon the soil thus made ready the saprophytes found a favorable condition for growth. Other concomitant microbes were those of diphtheria in 10 out of 4 cases. Thus given a receptive soil which is produced by diminished resistance in the lung tissue implantation of the saprophyte is believed to be the final stage in the production of abscess or gangrene.

The recognition of spirochetal pulmonary gangrene as an entity is attributed by Maes ( ) to Cristallani who described the disease in 1903. Cristallani (4) himself however





l t th l D b 3 40 D d d ft l t  
N t th l f t d l th l ft ppe l b

tites. Spirilla or spirochetæ have been occasionally seen in bronchial discharge by several author (Eichorst etc) but the parasites apparently were present in small numbers only.

Pilot and Davis (35) noted that when the dental tartar is examined fresh it presents brush like processes having central strand with coccoid and fusiform bodies arranged about the terminals. In the smear they found large numbers of coarse and fine spirochæte fusiform bacilli of various types leptothrix filaments and gram positive streptococci of the hemolytic or viridans type. In an anaerobic culture the fusiform bacilli produced a putrid odor in the tissue media.

In the faucial tonsils Pilot and Davis (35) found these organism in large numbers in the granular masses lying in the crypts which in their appearance were like actinomyces granules. These bodies are found in 30 per cent of extirpated tonsils and at some time are probably present in all individuals. They appear as foul gray or yellow single or multiple granules from 1 to 6 millimeters in diameter lying in the depths of the mouths of the crypts from which they may be expressed. Microscopically they are made up of filaments arranged in ray like structure unlike actinomyces but certainly with no true branching.



F b 4 D g RD l t l h l j t f b  
t m t f t l l t m l l d V l j 7 Tl  
d g d d d v l t

thread. They form a central shaft about which are small comma shaped fusiform bacilli and spirochetæ together with diplococci. The spirochetæ are gram negative and actively motile. The cocci are chiefly streptococci of viridans or hemolytic type the former often anaerobic in early culture. The bacilli are demonstrable in smear of culture in 80 per cent of extirpated tonsils. It would seem that a process similar to that of tartar formation occurs in the tonsil with the formation of spherical structures in the crypts instead of a film.

That these organisms are pathogenic and are not normal inhabitants of the mouth was proved by Davis and Pilot who found these organisms in putrid and gangrenous lesions of the body particularly about the teeth tonsils middle ear lungs and the genitalia. They reported 37 cases of pulmonary suppuration in which the fusospirochæte were found.

In addition to the work of Pilot and Davis we have the reports of fusospirochætal pulmonary suppuration by B S Kline (21) and his co workers Pona in 1905 (36) Iothwell in 1910 (37) Peters in 1911 (33) Dick in

1913 (10) and in 1918 the reports of Nolf (31) Parof (32) Thomson (40) and Weil (41). From this time on quite a large number of reports appeared in the literature.

Predisposition to fusospirochætal infection depends on many factors but as a rule the patients are weakened by other causes. Local foci such as pyorrhea or tonsils infected with fusospirochæta are of utmost importance. Pilot and Davis (35) state that the normal lungs do not harbor these organisms. They could not find them in 14 pairs of lungs which were free from any infectious process. On the other hand in certain abnormal conditions such as bronchiectasis, chronic bronchitis and bronchial asthma they found fusospirochæta in the sputum but the latter was not foul. These organisms under such conditions apparently lead a saprophytic life but in the presence of an acute respiratory infection or if the general resistance is lowered these saprophytic microbes may cause a putrid bronchitis and after spreading through the necrotic bronchial mucosa reach the lung parenchyma and produce single or multiple foci of suppuration or gangrene.

Experimental production of pulmonary abscesses has been successfully carried out only recently. Cutler and his associates (9) produced embolic lung abscesses. Aspiratory lung abscesses have been produced by Smith (39) in mice guinea pigs and rabbits. Within the last year Smith's work was carried to completion by the production of experimental aspiratory abscess in dogs by Crowe and Scarff (8), Duff Allen (1) and Hedblom, Joannides and Rosenthal (15). Recently Pilot (34) succeeded in producing aspiratory lung abscesses by injecting intratracheally material containing fusospirochæta into the lungs of rabbits and keeping the organisms down in the lung by using lipiodol.

#### EXPERIMENTS AND RESULTS

*Implantation of foreign bodies: peanuts, agar, agar, na y beans, pennies.* We began our experiments with this series because we felt that an implanted body would not be likely to be coughed up and would remain in the lung a sufficient length of time to cause the expected damage. We performed 14 such experiments on dogs. The substances implanted were roasted salted peanuts with their inner shell



FIG. 5. Dog 2981 (above). Injection of 30 cubic centimeters of blood and abscess sputum on July 13, 1927 followed by death 4 days later. Dog 2986 (below). Injection of 30 cubic centimeters of blood and abscess sputum on July 13, 1927 followed by death 3 days later.

agar, agar, dry navy beans and pennies. The technique of implantation was a modification of the one developed for lobectomy by Joannides (19). Under aseptic conditions an intercostal incision was made. Compressed air was used for the artificial respiration and sufficient pressure was exerted to allow the lung to expand moderately. An intestinal clamp with rubber tips was used to prevent air and blood leakage. With the lobe then immobile the lung was brought to the surface, a small opening made in it and the foreign body then implanted. The lung was sutured with a Garre suture and after the release of the clamp at the hilum the chest was closed.

Before closing the chest we examined the lung wound to see if it was air and water tight. The ribs were then approximated with heavy suture and the overlying tissues were closed in layers.

In the 14 implantation experiments we were unable to produce a characteristic lung abscess but always obtained a thick walled cyst surrounding the implanted foreign body. In 3 dogs we implanted salted roasted peanuts in 4 dogs small pieces of agar, agar containing a small piece of lead so that it could be localized by the roentgen ray and in 1 dog a penny was implanted. In the 6 remaining



showed a massive gangrene with an abscess involving the right lower and mediastinal lobe. The abscess was 6 centimeters in diameter and the lung at the site of the abscess was adherent to the diaphragm (Fig. 4). There was a bilateral pleurisy with hemorrhagic effusion. Smears from the abscess showed many fusiform bacilli and few spirilla; gram positive diplococci and streptococci.

In another series of 3 dogs 20 cubic centimeters of the same blood were injected into the lung through the bronchoscope and all 3 dogs died on the day following the injection. Two showed a massive pneumonia with pleurisy and effusion. The third dog (Dog 801) showed an abscess the size of a 10 cent piece in the right lower lobe and a massive pneumonia in the rest of the lung. Smears from the abscess area showed bacillus fusiformis gram positive diplococcus diphtheroids micrococcus catarrhalis gram negative bacillus but no spirillum of Vincent.

*Intrabronchial injection of citrated tonsillectomy blood and mixed with tonsil tissue and scrapings from the teeth of patients with pyorrhea alveolaris.* Six experiments were performed in this group. In each of 3 dogs we injected 10 cubic centimeters of 24 hour old citrated tonsillectomy blood mixed with pyorrhea scrapings and small pieces of tonsil tissue. One dog (No. 2811) died 4 days after the injection. At autopsy this dog showed multiple abscesses in the right lung. These abscesses varied from 5 millimeters in diameter. A large abscess 1 centimeter in diameter was found in the upper right lobe. This area was adherent to the chest by means of fibrous adhesions. The bronchi were filled with thick purulent fluid extending into the finer ramifications. The left lung presented a massive pneumonia with pleurisy but no abscess.

The second dog (No. 810) died 6 days after the injection and presented a bilateral pneumonia with pleurisy and hemorrhagic effusion but no abscess. The third dog (No. 2809) was killed 7 weeks after the injection. No abscess could be found. Both lungs were in a state of red hepatization. Clotted blood was found in the trachea and the larger bronchi leading to the upper left lobe.

In each of the 3 remaining dogs of this group 20 cubic centimeters of this mixture was used. It is striking to notice that in spite of the larger amount of blood used we found no abscesses in the lungs of any of these dogs. The blood used was from the same source in this entire group. The patient had had quinsy 2 months previous to tonsillectomy. On microscopic examination of the tonsil we found the characteristic fusospirochetal combination.

*Intrabronchial injection of gastric contents with or without pyorrhea scrapings bits of teeth and tonsillectomy blood during an abdominal operation.* In a series of 5 dogs we introduced into the lung through a bronchoscope human gastric contents containing 52.4 free hydrochloric acid and 66.4 total acidity. One dog (No. 803) that received 10 cubic centimeters of the gastric contents on May 4, 1927 was



11. Dog 3017. Intrabronchial injection of 30 cubic centimeter of fresh dog blood and sputum from clinical pulmonary abscess. Death occurred in 12 days.

killed on June 19, 1927, 9 days after the injection and at autopsy presented an abscess of the mediastinal lobe. Of the 4 remaining dogs 1 died 4 days after the injection and neither the lungs nor pleura showed any pathology whatsoever. The 3 other dogs died at 2, 3, and 5 days respectively after the injection showed an extensive bilateral pneumonia and pleurisy with hemorrhagic effusion but presented no abscess formation. Dog 803 appeared very sick 4 days before death. The animal was killed by means of an intracardiac injection of chloroform and at autopsy presented an abscess the size of a nickel in the mediastinal lobe. No fluid or adhesions were found in the chest.

We tried this same experiment in a group of 3 rabbits and 3 guinea pigs. In these animals we injected the gastric fluid through a tracheal needle. One rabbit that died 4 days after the injection of 1 cubic centimeter of the mixture developed an abscess of the left upper lobe. The remaining animals showed pneumonia but no abscess.

In 3 dogs we performed an abdominal operation while a mixture of gastric contents, bits of teeth, pyorrhea scrapings and 24 hour old tonsillectomy blood was slowly injected through a bronchoscope into the lung. In Dog 2839 we injected 15 cubic centimeters of this mixture on May 27, 1927 and killed the dog on July 5, 1927. At autopsy we found a hard mass in the right upper lobe but on sectioning we found no fluid or foreign body in the center of this mass. The 2 other dogs were killed 1 month after the injection. In 1 dog we found no lung or pleural pathology while in the other we noticed that the lungs were speckled with small hemorrhagic areas which on sectioning showed clotted blood. We also noticed small bullae in the visceral pleura but found no typical abscesses.

In log 1 injected the dog so n freshl y l tted  
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p o h a p t i e n t E n t y cubic cent m t r s wer  
low l i j e c t d i n each of these dog h l e ab  
d m i n a l p e r a t i o n was being p e f o r m d Dog 874  
a j t e d o n J u e 7 1 0 7 and d i d o n J u n e  
9 At autops y e f o u n d a b i l a t e r a l p u m n i a  
l a b s c e s i n the medi s t i n a l l o b e Th other  
log d i l 6 l y s a f t e r the i n j e c t i o n a n l p r e n t d  
l u n g o r p l u r a l p a t h o l o g y

The s p e r m e t s t l t o h o t h a t g a s t r i c o n t e n t  
p e w h e r s p r a t l m a y c a u s e i p u l m o n a r y  
b W h t r o n a t a n a l d m a l p e a t i n i  
f a n m p r t a c i t h p r o l u t i o n o f a b s s o f  
t h l u g d e p e n d n t r l y u n o n e f a t r I f d u r  
g n b d o m a l o p e r a t i o n the p a t i e n t m i t i f  
t h h a l i s r a i s e d h i g h e r t h a n t h l o f t h f t  
f t h n a s t a d u m s t h p a t i n s s d p  
t h t t l u g h a n l s a l l o n g r i l x s a r a b o l i s h i  
e h o n d t o t h t a r e f o r b l t o b c s  
p r j u t i Th t t h a b l e t i n o f the c o u g h r f l

v v i m p o r t a n t i n t h l l o p m t o f a l s s o f  
the l u n g a s m p r s s e d u p o n u h e n e s a v  
p t l l y t h m u u b l d o r g a s t r i c c t n t s  
t h t i j e c t d o m r i g h t u p n t the m o u t h w h n  
t h m a l s n o t l p l y n a t h e t i z e d M o r e o  
i o e m a l e i n t o d u d a t o o t h t h r u g h t h  
b r n c h o p e A s s o n a s t h t o t h w b l o w n n  
t o d t h t h u m t c l o s t h o p e n g f t h  
b r n h o p Th t t h v t l w n t k r y  
p r o p t l l t h u b a f o r e t h a t t p i e c i t h  
t h u m b d u l i n f c t n

I t a l I l l j t i f b r t l s p f  
p l s p e b p t m i x d w i t h  
i l l p e s i f f i d t l t l s n l p i e c f  
f e l t l t s I n dog c i j e c t e d o u b i c  
n t m t o f b r o t h s u s p e n s i o n f p y o r r h e a s c r p  
i g m i x d v t h s m l l b t s o f i n f t d t e e t h Both  
l o g s r k l l e d 38 d a y s i t e r the i n j e c t i o n D g  
8 d v e d t h i n j e c t i o n n M a y 17 1 0 7 and  
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o f s p r o c h e t e f i n e n t The s m e r s h o d m a n y  
f u f o r m b a c i l l d p h t h e r o d s a d g r a m p o s i t i v e  
d p l o c i The s e c o n d d o g p e s n t d n o l u n g p a  
t h o l o g y w h e n k i l l e d 38 d a y s a f t e r the i n j e c t i o

I n c h f 7 d g s e i n j e c t e d o u b i c c e n t i m e t e r s  
o f s p u t u m f r o m a p u l m o n a r y a b s c s s p a t i e n t o f D r  
H b l o m The s m e a r o f t h s p u t u m s h o e d the  
h a r a c t e r i s t i c f u s o s p r o c h e t l c o m b i n a t i o n W o b  
t a i n e d a b s c e s s n o f t h s e d o g s Dog 2890 r e  
v e d the i n j e c t i o n o n J u n e 8 927 and d i d o n  
J u n e 9 927 At autops y e f o u n d a b i l a t e r a l  
p n e u m n i a n a n a b s c s o f the m e d a s t a l l o b e  
t h t h i n f i b r i n o u s a d h e o n s b e t e n t h l o b e a d  
t h d p h r a g m D g 2889 r e c i v e d the i n j e c t i o n o n  
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a t o p s y w e f o u n d a b s c e s e s n the l e f t u p p e r and  
r i g h t l o e r l o b e s Th e s r m a i n i n g d o g d i d n o t  
d e v e l o p a b s c e s s e s

I n e a c h o f 3 d o g w e i n j e c t e d 15 c u b i c c e n t i m e t e r s  
o f a b s c e s s s p u t u m a n d a l s o i m p l a n t e d s m a l l p i e c e s  
o f f r e s h t o n s i l t i s s u e O n e d o g d i e d 8 d a y s a f t e r  
t h i n j e c t i o n a n l a t a u t o p s y s h o w e d a p n e u m o n i a  
o f b o t h l o w e r l o b e s b u t n o a b c e s s The 2 o t h e r  
l o g s e r e k i l l d 13 a n l o d a y s a f t e r the i n j e c t i o n  
a n l a t a u t o p s y n e i t h e r s h o w e d a n y l u n g p a t h o l o g y

The p e r c e n t a g e o f a b s c e s s f o r m a t i o n i n t h e s e d o g s  
s n t v e r y h i g h b a u s e the s p u t u m c o u l d b e e a s i l y  
c u g h l e u p a s s o o n a s t h a n i m a l w o k u p I n  
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l g I f o n the o t h e r h a n d w e s u s p e n d e d the  
s p u t u m i n a f l u i d t h t v a l l b e e n t r a p p e d i n the  
a l v l i t h f r e c a n t a g f a b s c e s s w o u l d n a t u r a l l y  
b h i g h e r F r s h b l o o d o r f r e s h l y c l o t t e d b l o o d  
w o u l d m a k e n i d e a l m e d i u m f r s u c h e p e r i m e n t s  
b e c a u s e the f b n m u s h e s v a l l h a v e a g r a t e r c o  
h e i v p o w e r i n the l u n g d a t t h s a m e t i m e s h u t  
o f f the a i r u p p l y f t h p a r t t h u p r o d u c g f a v o r  
b l n r o l l o n d i t i s W e t r i d t h s p r o c e d u r e  
i n o u r n e x t s e r i a n l o b t a i n l a n u s u a l l y h i g h  
p e r c e n t a g e o f a b s c e s s e s

I t b o f a l l t y t o t i f f s l f s h l y c l o t t d  
d k o u b l d x d w i t h p t e r f o m a p a t i e n t  
w i t h l i g a b c e s W e i n j e c t e d t h i s m i x t u r i n t o 14  
k g I n 10 f t h e s a n i m a l w e b t a i n e d e i t h e r  
a n g l o m u l t i p l b s c s s The a b s c e s s e s v a r i e d  
n f r o m a f o r m i l l i m e t e r s t o 3 c e n t i m e t e r s  
A l t h o u g h t h l o r l o b e s a n l the m e d i a s t i n a l l o b e  
e r m o s t c o m m o n l y l i v e d w f o u n d t h e m a l o  
i n the u p p e r l o b

D g 2981 r e c e i v e d the i n j e c t i o n o n J u l y 13 1927  
a n d d i e d 3 d a y s l a t e r At autops y a n a b s c e s s the  
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l o b e ( f g 5) S m a r s f r o m t h a b c e s s s h o v e d  
f u f i r n b a c i l l d p h t h e r d a n l g r a m n e g a t i v e  
b a c i l l i Th a b e s r u p t u r e d i n t o the p l e u r a l c a v  
i t y a n d w a l l d o f f b y m a s o f t h i n f i b r i n o u s  
d h n B o t h s i d e s o f the c h e s t v e r e f i l l e d w i t h  
t h i k b l o o d y p u s Th r e v a s a n a c u t e a n t e r i o r  
m l i a s t n i s h i l the p e r i c a r d i u m a s c o r e d  
w i t h a t h i c k b r e a d a n l b u t t e r s u d t e The l u n g  
e r d o u g h t d d d n o t c r e p i t a t e T h e y v e r e f  
d r k p u r p l c o l o r

Dog 2982 r e c e i v e d the i n j e c t i o n o n J u l y 13 1927  
a n d d i e d 3 d a y s l a t e r At autops y t h s d o g p r e s e n t e d  
a g a n g r e n u s i g h t l o e r l o b e w i t h a r u p t u r e d a b  
s s s s e s s i z e o f a s i l v e r d o l l a r Th e a s a l o a  
s m a l l e r a b s c e s s n the u p p e r l e f t l o b e Th e r s  
a n a c u t e f i b r i n o p u r u l e n t p l e u r i s y a n l a n a c u t e a n  
t e r o m e d a s t n i t i s B o t h s i d e s o f the c h e s t w e r e  
f i l l e d w i t h b l o o d y t h i c k p u s The l e f t u p p e r l o b  
a n l i g h t l o e r l o b e v e r e a d h e r e n t t o c h e s t v a l l

Dog 2983 l e d 14 d a y s a f t e r the i n j e c t i o n At  
a u t o p y s u c h the a m e i n f i n g a s i n d o g s 2981 a n d  
98 w e r e n o t i c e d Th m e d i a s t a l l o b h a l m u l  
t i p l s m a l l a b c e s s e s

Dog 985 d i e d 24 h u s a f t e r the i n j e c t i o n I n  
a d d i t i o n t g a n g r e n e o f t h m e d i a s t i n a l a n d t h l f t  
l o e r l o b s t h e r w a s a r u p t u r d a b s c e s 3 b y 2  
c e n t i m e t e r s i n d i a m e t e r The l f t l o e r l o b w a s  
a d h e r e n t t o the c h e s t w a l l a n d the d i a p h r a g m

Dog 2986 died 3 days after operation. At autopsy a ruptured abscess in the left lower lobe was found. Dog 2988 was killed 12 days after the injection and an abscess in the left lower lobe was found. Dog 2989 died 8 days after the injection and presented an abscess in the mediastinal lobe. This abscess involved the major portion of the mediastinal lobe and was the size of a 50 cent piece (Fig. 6). It contained a thick cheesy mass. There was no communication with the bronchus. The abscess had ruptured into the chest cavity. Dog 3017 died 1 days after the injection and showed multiple abscesses in the right upper lobe (Fig. 7). Dog 3019 was killed 6 days after the injection. At autopsy the lung showed multiple small abscesses in the left lower lobe. Dog 3021 died 4 days after operation and presented an abscess in the mediastinal lobe. Sections from the abscess wall showed characteristic polynuclear infiltration and microscopic abscesses. Dog 2988 received the injection on July 13, 1927 and was killed on July 25, 1927. An abscess in the left lower lobe was found. Dog 3019 was killed 6 days after the injection and at autopsy presented abscesses in the left lower lobe.

In this series the majority of abscesses were found within the first 5 days after the injection. In 1 case the dog when killed on the twelfth day presented an abscess. These findings are quite in contrast with the paranasal sinus experiments. In these experiments the abscesses were of the chronic type, whereas in this last series abscesses were found as early as 4 hours after the injection. The fact that we notice multiple as well as single abscesses in these aspiratory abscesses seems to disprove the contention of certain workers who assume that multiple abscesses are generally embolic in origin. The high percentage of abscess formation in this series is undoubtedly due to the injection of freshly clotted blood. With the formation of fibrin meshes this blood was entrapped in the alveoli and in the presence of the fusospirochetes formed an ideal background for abscess formation.

*Intrabronchial injection of pure cultures of staphylococcus aureus and albus mixed with fresh dog blood.* Ten dogs were injected with 10, 20 and 30 cubic centimeters of the mixture. Two out of the 10 died 7 and 9 days after the injection. The rest were killed at intervals from 4 to 16 days after the injection. No abscesses were found in any of these dogs. We noticed however at various parts of the lung hard lumps 1/2 to 1 centimeter in diameter with a hard white center much like the foreign body reactions of other implantation experiments. A dissection of the bronchial tree revealed a thick sticky mucopurulent bronchitis extending as far down as the smaller ramifications of the bronchial tree.

From this group of experiments we can assume with a reasonable degree of certainty that it takes more than blood and pyogenic organisms to cause pulmonary abscesses in the dog. Masses such as those we found in the staphylococcus experiments have been described by Corper, Kretschmer and

Lurie (7). Corper and his associates state that normal unclotted blood which has been injected intratracheally into rabbits immediately after withdrawal from the internal jugular vein is rapidly aspirated into the finer air divisions where it is retained and induces a proliferative reaction on the part of the pulmonary tissue. After all local pigment has disappeared there still remains a distinctly palpable induration at the site of localization due to proliferative pneumonitis occasioned by the presence of blood in the finer pulmonary division.

*Intratracheal injection of blood mixed with bismuth subcarbonate with the animal lying in a horizontal position.* We injected 50 cubic centimeters of the mixture into each of 2 dogs and studied the distribution with the X-ray. As expected the bismuth diffused itself fairly evenly throughout the whole lung. We can assume therefore that with the introduction of infected blood no part of the lung would be immune but the greater tendency for involvement would be in the portions of the lung to which the blood would naturally gravitate. This is undoubtedly the reason for the greater frequency of lower lobe or mediastinal abscesses.

#### COMMENT

Out of a total of 87 experiments we noticed abscess formation in 21 dogs or a total of 24 per cent. By using fresh blood and abscess sputum we were able to obtain abscesses in 10 out of 14 dogs or 71.4 per cent. An implantation of a foreign body infected only with ordinary pyogenic organisms is well tolerated in the dog's lung. A sacculus is formed which encapsulates the foreign body and thus makes it innocuous. Intrabronchial injection of blood plus staphylococcus produced changes similar to those found by Corper (7) after the injection of pure sterile fresh blood. Apparently the lung of the dog is immune to the ordinary pyogenes so that when it is injected with fresh blood we can produce only a reaction characteristic of the aspiration of sterile blood. On the other hand aspiration of either pyorrhæa scrapings or abscess sputum causes a lung abscess. A broth suspension of pyorrhæa scrapings does not cause a high percentage of abscesses. Our experience was the same with the aspiration of plain abscess sputum which is usually thick and tenacious and on aspiration acts very likely as a large sized foreign body. It undoubtedly stays in the larger branches of the bronchial tree and is easily coughed up as soon as the animal wakes up. Such is our experience also with

the aspiration of larger foreign bodies such as bits of teeth or pieces of fresh tracheal tissue. In not a single dog were we able to find any of the foreign bodies in spite of the most careful search.

Knowing from the experience of List in his co-workers with (9) Craven and Scribner (5) Duff Allen (11) and Hedblom, Jennie and Potentill (12) that the presence of fusopirichetia is quite important in the etiology of lung abscess and knowing from the work of Cooper and others that blood will find its way into the smallest ramifications of the bronchial tree and remain there and become organized we can assume that we have found both the cell and the condition to prepare the soil for such infection. Aspiration of infected fresh blood during or soon after an operation in the neighborhood has given the highest incidence of postoperative lung abscess. We have been able to duplicate clinical conditions by infecting fresh blood with fresh abscess putum rich in fusopirichetia. In such experiments we have been able to obtain single or multiple abscesses in 14 per cent of our dogs. In 8 out of 10 dogs which developed abscesses the lesions were acute and appeared from 1 to 6 days after the intrabronchial injection. It is very likely that the infection was operative and so many areas became involved that the dogs died promptly. Such was not the case however when pyorrhoic scrapings were aspirated. Under such conditions we found in abscesses of the right upper lobe in a dog that we killed 8 days after the injection. Chronic abscesses also have been produced as a result of a chronic pyramidal injury of the fusopirichetia type. Tissue rich in fusiform diphtheria and pyorrhoic could be noticed in the nose of our animal. In 1 per cent of our frontal sinus experiments we found abscess formation. In all cases the abscesses were found after a prolonged period, namely 1, 6 and 10 days after the intra operation. There seems to be no doubt that the fusiform bacteria found its way into the lung thus eventually causing abscess formation.

The introduction of infected material into the lung does not always produce abscesses. In a certain percentage of the animal killed

1 to 100 days after the injection no lung pathology whatever was revealed. A certain proportion of the dogs showed a unilateral or bilateral pneumonia of the lobar type. The lower lobe and the mediastinal lobe were most frequently involved. Another group of them developed gangrene of the lungs and finally a certain percentage showed abscesses of varying size. Just why one should be able to tell the causation is difficult to tell. It is possible that the protective mechanism in the lungs varies with the different animal.

The following factors are of great importance in the production of lung suppuration.

1. The abolition of the pharyngeal and esophageal reflexes in general anesthesia.

2. The presence of mucus or blood in the mouth during the operation.

3. The presence of certain characteristic microorganisms in the buccal cavity (fusopirichetia).

4. The presence of chronic infection in the nose, mouth and pirichetia in the nose.

The lumen and the physical state of the aspirated material. Thus the maller the foreign body the further it will reach in the tracheal tree. A thick tenacious fluid that has a low specific gravity is less likely to stay in the lung than a thinner less tenacious heavier fluid.

5. The action of the cilia which clear the trachea and bronchi by rhythmic movement.

Specific immunity in the lung against certain organisms. For example the lesion that is noted after the introduction of fresh blood and a pure culture of typhlococcus aureus and albus are characteristic of the one noticed with sterile blood. It appears that under ordinary conditions the typhlococcus does little harm to the lung of the dog.

The lesion may be single or multiple acute or chronic. We have been able to produce chronic abscesses by allowing only small amount of pus to trickle down from the nose of the dog into the lungs. On the other hand we have found abscess formation within 4 hours after the injection. The abscesses varied in size from a few millimeters to a size equal to that of 1.5 centimeter.

Some abscesses ruptured into the pleural cavity and caused a fatal acute pleurisy with

effusion. Usually at the site of the abscess we found fibrinous or fibrous adhesions between the lung and the neighboring organ or the chest wall.

In the acute abscesses a wall was not well formed but in the more chronic types we found a wall 1 to 3 millimeters thick and the contents varied from pus to thick cheesy material. The abscess does not necessarily communicate with the bronchus in these aspiratory experiments. In one experiment in which we obtained the largest abscess we could find no communication of the abscess with a bronchus. The wall surrounding the abscess was uniformly tough.

The pneumonia that was noticed was usually of the lobar type. In some animals we noticed a pneumonic process in immediate neighborhood of bronchus. This type of lesion was of relatively infrequent occurrence.

Foreign bodies implanted in the lung induced the development of a thick walled foreign body sac that showed no evidence of infection and that surrounded this body very intimately. This lesion was produced by the implantation of peanuts, beans, agar, agar and pennies.

When blood with staphylococcus was injected intrabronchially and the animal developed lesions we noticed a thick kernel like induration without a soft center. This varied in color from red to grayish yellow. On section a hard cartilage like center was found.

## BIBLIOGRAPHY

- ALLIN DUFF: Histology of abscess of the lung. Arch Surg 19 8 xvi 1 9-19.
- BABL: Semae eméd 1893 xv 528.
- BACILLI: Quoted by Hellom loc cit.
- CHATHAM: A Note on a peculiar form of hamoma. J Am Med Ass 1923 lxxviii 18 8 186.
- CHAYTOR: I A Lungal case following operation upon no e l throat. Int nat Clin 1916 65 11 73.
- CHAPMAN: H J Pulmonary aspiration of particulate matter normally and during anesthesia. J Am Med Ass 1923 lxxviii 18 8 186.
- CHAPMAN: H J KRETCHMER: O S TURK: M A B: An experimental study of experimental abscess of the lung. Am J Ex Physiol 1933 xvi 1 6-19.
- CROW: S J and SCARFF: J J: Experimental abscess of the lung. Arch Surg 1928 xvi 1 6-19.
- CUTLER: L C and SCHILLER: S A: The experimental production of abscess of the lung. Ann Surg 1916 lxxvi 56-20.
- DICK: Luiform bacilli associated with various pathological processes. J Infect Dis 1913 xii 191 25.
- DRESSER: Johns Hopkins Ho p Bull 1893 1.
- GUMPERT: J J: De pulmonum abscessu. Chirurgia Perendo Coetinae 1793.
- HIDALGO: C A Pulmonary suppuration. Med I 1919 xvi 44-43.
- HELM: See discussion of article by Lemon (4).
- HELLMOM: C A JOANNIDIS: M ROENTGEN: S A: A study of the lesions of the lung in the experimental production of pulmonary suppuration. Surg 1926 xvi 1 1 1874 15 7.
- HOLMAN: I WIDELIN: I I SCHILLER: S A: Experimental production of lung abscess. Soc Exper Biol & Med 1916 xvi 266.
- JOANNIDIS: M: Surgery of the lung. Case of the tuberculous lung. Arch Surg 1926 xvi 1 1 1874 15 7.
- JOHN: B S: Spirochetal pulmonary gangrene. J Am Med Ass 1921 l 1 1874 15 7.
- JOHN: B S: Experimental gangrene. J Infect Dis 1923 xxvii 48 483.
- KLINE: B S and BERGER: Spirochetal pulmonary gangrene with arsenphenamine. J Am Med Ass 1925 lxxv 1452 459.
- KLINE: B S and BLANKENHORN: M A Spirochetal pulmonary gangrene. J Am Med Ass 1925 lxxv 1452 459.
- LEMON: W S: Aspiration and experimental tuberculous. Arch Surg 1926 xvi 1 1874 15 7.
- LYDEN: J and JAFFE: M: Putrid (fetid) putrefaction. Deut Arch f klin Med 1896 11 488.
- LODGE: T T: Pulmonary abscess. Boston Med & Surg J 1915 cxvii 85-88.
- MAES: U: Spirochetal pulmonary gangrene. Internat Clin 1916 65 11 73-77.
- MURPHY: J B: Surgery of the lung. J Am Med Ass 1926 lxxvi 281.
- MYERSON: M C: Bronchoscopic observation on the cough reflex in tonsillectomy under general anesthesia. Laryngoscope 1924 xxxi 63.
- NEHR: L: A case of follow-up of the tuberculous. Arch Otol Rhinol 1915 5 1 137-146.
- NEHR: L: Tetid spirillar bronchitis and pulmonary gangrene. Arch Int Med 1920 xiv 4 9 448 Bull Acad m éd 1918 xxxv 80 6 7.
- PARROT: Pulmonary gangrene. De la mine l by the association of Vincent's fusiform bacilli. Bull t m m So med h op d Iar 1918 lvi 1.
- PETERS: Hand infection apparently due to bacilli fusiformis. J Infect Dis 1911 xvi 455 46.
- PILOT: I: Ier onal communication.
- PILOT: I and DAVIS: J J: Arch Int Med 1924 xxiv 313 354.
- RENA: Arch f De mat u Syph 1911 1.
- ROTHWELL: Bronchial abscess. Angina. J Am Med Ass 1910 lvi 867.
- SCHENK: Quoted by J B Murphy: Surgery of the lung. J Am Med Ass 1926 lxxvi 151.
- SIMON: DAVID: T: Experimental aspiratory abscess. Arch Surg 1917 xiv 231-40.
- THOMSON: I: Iulm n ry p roch to l. Brit Med J 1918 11 100 10.
- WILL: I: A gangrene pulmonie dans la grippe. Bull Soc m d d l o g de Iar 1918 xvi 119.
- WINTHROP: C I: Pulmonary abscess. A gangrene. Boston Med & Surg J 1918 131 2 1.



A STUDY OF GANGLION<sup>1</sup>

WITH ESPECIAL REFERENCE TO TREATMENT

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F m th I p m t f I h I bo t r y f I P h l g y Th Pr by H f I Col mb U

**A** GANGLION is a cystic swelling usually occurring in close proximity to joints and tendon sheaths and containing a thick mucinous fluid. The regions of the wrist, ankle and knee and the volar regions of the fingers and hand are most frequently affected.

## GENESIS

The many hypotheses dealing with the origin of ganglia have added an interesting chapter to their study. The various arguments that have been advanced show that no definite conclusion regarding their genesis has as yet been reached. Even today many accept the popular belief of the middle of the last century that they are hernial protrusions of synovial membranes or tendon sheaths. The following are brief summaries of hypotheses that have been given:

1. A knot of tissue. This is perhaps the oldest conception of the pathology and the Greek word γαγγλιον from which the word ganglion comes expresses the thought. Hippocrates (10) refers to it and says that it contains mucoid flesh (μῦς αὐδ αὐρ καὶ) <sup>3</sup>

2. Puncture of tendon sheath. In 1746 Eller (4) found a ganglion adherent to a tendon sheath. He examined it microscopically and concluded that the sheath had ruptured and that the fluid contained in the ganglion came from the sheath space with subsequent healing off of the opening made by the rupture.

3. Retention cysts. Gosselin (8) in 185 thought that they were retention cysts coming from a combination of the corpuscles of synovial and cryptes synoviales (subsynovial follicles and crypts).

4. Neoplasms. Henle (9) in 1847 regarded them as mucinous tumors. Meckel (16) in 1856 as serous cysts and Hoeftman (11) in 1876 as synovial dermoids. Ledderhose (15) in 1893 in addition to considering them degeneration cysts also thought that they were true neoplasms. Floderus (5) in 1915 said that ganglia are true neoplasms arising from an arthrogenous blastema, i.e. a specialized connective tissue destined through growth and degeneration to form joints and tendon sheaths. On this basis he suggested that ganglia be called arthromas. Kuettner and Hertel (14) agreed that ganglia were neoplasms.

5. Herniation of tendon sheath or capsule of joint. This hypothesis was discussed by Volkmann (4) in 1882 and by Billroth (1) in the same year. The latter left open the question of communication of ganglia with joints or tendon sheaths.

6. Origin from bursa. Vogt (3) in 1881 offered this opinion.

7. Degeneration cysts. Ledderhose (15) in 1893 and subsequently Thorn (2), Pavr (18), Franz (7), Borchardt (2), Hofmann (1), Iitschl (20), Clarke (3) and Thomson (1) advanced the idea that they were cystic degenerations in the connective tissue outside a joint.

## PATHOLOGY

For some years we have been interested in the origin of ganglia. We have made notation of operative findings and have studied pathological sections and the chemistry of the cyst contents. In no instance have we been convinced that ganglia resulted from direct communication with joints or sheath spaces. On several occasions the joint has been exposed but only for one of two reasons, namely operative trauma or an almost complete disappearance of the capsule and further in these instances the cyst wall has been complete and its contents have had no connection

W h l d d c y f h m l n a c a l a g i n h j  
S p a k u n i l l h p f f d d h h d h t h h  
m h i p b o d d h m h k d h t h h  
l d w h p f i d h m h k g m h t h h  
h x p T h d d h m y p e h m h k g m h t h h  
h b b d h h h m y p e h m h k g m h t h h  
f h m d h h m y p e h m h k g m h t h h  
b i n p h a r m d p y a t m b i n g d p

R d b f th i s y n w y k a d m y f M d A 16 8



Fig. 1 Case history 164640 A typical multilocular ganglion of the dorsal surface of the wrist of 3 years duration in a 4 year old female It was attached to the capsule of the wrist joint and extensor tendon sheaths

with the fluid in the joint The growths are attached to capsules of joints tendon sheaths or both What is left of this connective tissue apparently varies with the amount of degeneration it has undergone

We believe that the so called false ganglia (those communicating with joints) and a similar cyst which Pick (19) found communicating with the wrist joint postmortem are also evidences of complete degeneration of the capsule of the joint Operative trauma might also produce such a communication

The lesion consists essentially of a chief cyst which may be unilocular or multilocular surrounded in almost every instance by a group of accessory cavities ranging in size from microscopic up to an equality with the main cavity (Fig 5) The wall of the main cyst is made up of a dense fibrous tissue resembling that found in the capsule of a joint There is often a dense smooth shiny white membrane lining the lumen This is simply a condensation of the fibrous tissue of the wall and has no special lining cells

As a rule the cysts are filled with a thick sticky colorless fluid of the consistency of soft jelly (*gelee de pomme*) which is probably



Fig. 3 Case history 83726 A characteristic ganglion of the volar surface of the foot of 4 months duration in a 26 year-old female



Fig. 2 Case history 164640 Photo aph of specimen excised from case illustrated in Figure 1

of the nature of mucin<sup>1</sup> Rarely the fluid is described as watery and occasionally it has been tinged yellow red or brown by blood pigment

A striking feature of the microscopic picture is the presence of what seem to be areas of degeneration scattered through the cyst wall (Fig 7) and in the surrounding

W th th dd t f t d l d pp wh h d t d  
pp f th dd t f d b t d wh lk l is dd d  
Hydr lys w th t t d h y dr hl m t al t un pl  
t wh b d B di t i t Th m t al t un pl  
bl ham t yl d h l g t gy t d t  
All f th t t h w b ha t m l t th t fm un B l g t  
ddly g g gul m wh h l d lb mn d gl b l  
M t f th t t w m d by D Lo B m  
A tt mpt m d t l ar m th g bo t th b h v fm un  
th t by t pl t g gangl b th th b t  
t f d g b k l y f w d s th d l pp ll g  
t d th tt mpt w t p t d



Fig. 4 Case history 9522 Photo rapl of a ganglion of the dorsal surface of the foot of 3 months duration in a 1 year-old female It was a p rated and injected with half strength tincture of iodine Four years later there was no evidence of re appearance





Fig. 8. Case history 43388. Photomicrograph showing two bundles of nerve fibrils (A) surrounded by thick, irregular sheath pathologically characterized by degeneration. To the right of them is a small cyst cavity. The marked multiplicity of the dense fibrous tissue about the area of degeneration should be noted. (From Stout and Clarke (11))

degeneration both in the multiplicity of foci and in the regular cyst formation. This observation leads one to suspect that the tissue increase is coincidental with the accumulation of the mucinous fluid because of the frequency with which the entire process ceases following its dispersal and absorption or its withdrawal by aspiration.

The walls of the larger cysts are sparsely supplied with capillaries but no more so than the dense capsular tissue of joints. In the looser surrounding tissue there is usually a rather rich vascular supply. With great regularity one finds that the larger vessels have very small lumens due to marked fibrosis of the walls. Even the capillaries are often thickened. Kutsch (10), Horn (2) and others have suggested that these vascular lesions may have caused a local impairment of nutrition with resultant degeneration. We feel however that this hypothesis is inadequate first because such vascular lesions are commonly found in the neighborhood of most chronic inflammations where no such mucinous degenerations are found second because patent blood containing capillaries are often found passing through and presumably furnishing nourishment to these areas of degeneration (Fig. 11) and finally because the process often ceases following aspiration of the cyst contents a procedure which can hardly have much effect upon the



Fig. 9. Case history 1006. High power photomicrograph of cells in an area of degeneration showing the irregularly shaped cells with long cytoplasmic processes extending out from them. Many of the intercellular spaces are probably undergoing mucinous degeneration. The intercellular space probably contains mucin.

blood vessels. We feel as do Pryor (18) and Kuettner (13) that the vascular change is probably secondary to or concomitant with the cyst formation.

There is remarkably little evidence of inflammatory cellular infiltration in and around these lesions. The usual finding is the presence of a few mononuclear wandering

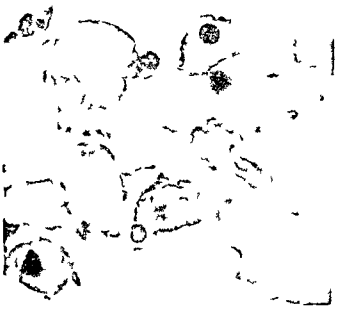


Fig. 10. Case history 31. A photomicrograph showing mononuclear cells in an area of degeneration. The cells are irregularly shaped and contain mucin.

TABLE I—ANALYSIS OF 255 CASES

Age (years)	Sex	Site	Diagnosis	C	P
— 5				7	2 4
6—				14	5 43
—				86	33 73
— 3 (Age 16)				83	32 51
3—4				27	0 57
4—5				18	7 4
51—60				11	4 3
61—				6	2 3
7— 6				9	3 7
S					
I emal				9	4 5
M l				6	49
O					
H u			fe	72	8
S hool			h l l	56	83
M d				9	3 5
M l l n u				18	46 4
Tr					
l e at				9	3 97
N t p			t	40	54 9
O stu			all	3	14 12
I					
D rsum			f w t	175	68 00
V l r su			f t	47	7 5
V ol r			fa f t g	1	5 1
D rsum			off t	1	3 9
D r l			rf ce of t g	3	1 18
l pl t			l r g	3	1 18
L te			l g f m l l	0	8
Indef			t n	0	7 1
(d t)					
L g st			6 m		
Sm l le			t mm		
M t			omm n m		
I					
P			t	3	44 32
N t p			e t	1	43 14
Q t			n l l	3	53
I r d n					
I re nt				73	5 63
N t p			nt		48 98
Qu t			n l l	57	34
O					
C l ul			f t j t	0	51 4
Ext			r t do st l l	4	1 84
H e r t			d h th	9	8
Tendo			h ath	4	3 6
D te				1	75
U l st			d	3	1
T					
O p e			t e	09	4 75
N o t			atm t	8	3 77
B k			g	1	2 55
V l t			n nd j e t	6	6 75
St a p			g d p	7	2 74
B k g			n l m g	5	1 96
V p i			t n n t p e	3	1 8
N av				0	8

cell in the immediate vicinity of some of the smaller vessels. Occasionally associated with trauma, hemorrhage or infection, larger numbers of mononuclear cells and polymorphonuclear leucocyte are found to be present.

It has been stated by some authors that ganglia have been found forming in tendons, periosteum and nerve sheaths. As we have not observed any associated with tendons or periosteum we cannot confirm this. In regard to nerves we have frequently observed bundles of fibers passing through the areas of mucinous degeneration (Fig. 8) and have found them adherent to the radial nerve at the wrist but as all of these cysts were in close approximation to a tendon sheath or capsule we felt that the nerve involvement was a chance one. This close connection with nerves may account for the pain and tenderness which are often associated with some ganglia.

We have not observed nor read of malignant neoplasms arising from ganglia. Spontaneous infection of ganglia occurs very rarely. We have never observed spontaneous rupture of a ganglion through the skin but one patient stated that his ganglion had ruptured spontaneously through the skin.

#### ETIOLOGY

Many authors have discussed direct trauma, continued or sudden, hard or unaccustomed use of joint or tendon and individual constitutional tendency as causes of ganglia.

TABLE II—TREATMENT AND LATE RESULTS IN 255 CASES (CARP AND STOUT)

M t h d f t t m t	C	P t	C f l l w d (t t l—y)	L o g t t u n (m )	S h t t t m (m )	A . g t m e (m )	R p p	D p p	St ill p t
Operative	109	4 75	35	168	3	28 0	11 (31%)	4 (69%)	
None	81	31 77	12	60	3	36 5		7 (58%)	5 (42%)
Breaking	32	12 55	9	48	4	12 0	2 (22%)	7 (78%)	
Aspiration injection chemical irritant pres- sure	16	6 75	8	72	1	55 5	(25%)	6 (75%)	
Strapping and pressure	7	2 74	3	48	1	20 0			3 (100%)
Baking and massage	5	7 96	1	10					1 (100%)
Aspiration and pressure	3	1 18	2	15	6	10 5	2 (100%)		
X ray	2	0 78							

It is difficult to conceive of direct trauma to the dorsal surface of the wrist as the primary cause of degeneration of the dorsal carpal ligament as this ligament is well protected by overlying tendons. Some patients ascribe the appearance of the swelling to a definite trauma. Kuettner (13) found trauma in 20 per cent of his cases. On the other hand there are many traumata to this region without subsequent formation of ganglia and it is hazardous to stress this as an etiological factor.

The importance of constitutional tendency is difficult to establish. The fact that complete excision of the ganglion has not as a rule been followed by a re appearance is not easily explained.

The preponderance of ganglia in the second third and fourth decades in females of slight build is generally a striking observation. The progressive diminution of the number of cases after the fourth decade and their comparative rarity in old age is also striking.

#### ANATOMY

Those ganglia arising from the capsules of joints are intimately adherent to them usually by a broad base so that they can be excised only by sharp dissection. We have not been able to note a definite pedicle. Tendons are usually pushed aside by the cyst which also becomes adherent to tendon sheaths when these are present. On the dorsal surface of the wrist ganglia may occur on the radial

ulnar or middle aspect. In most instances they are found over the articulations between the navicular and lunate bones and the lesser multangular and capitate bones. Laterally they are bounded by the extensor longus pollicis and medially by the extensor communis digitorum and extensor indicis. The ganglia on the volar aspect of the wrist lie as a rule laterally between the tendons of the flexor carpi radialis and supinator longus. Here they are in close relation to the radial artery and in one of our cases this artery coursed directly through the capsule of the ganglion. On the volar surfaces of the fingers the ganglia are intimately attached to the flexor tendon sheaths usually at their bases and in some instances they are also adherent to the skin.

#### SYMPTOMS AND SIGNS

The symptoms may be grouped under deformity function and pain. The swelling may come on gradually or appear suddenly or the patient may give a history of alternate increase and decrease in its size. Quite often the chief complaint is a bone out of place or a weeping sinus. About half the patients complain also of pain which may be present only on use of the adjacent joints or may also radiate from the region of the swelling. Encroachment of the cyst on tendons frequently produces a sense of weakness in the fingers or toes to which the tendons go. The swelling may be very large or very small. On

TABLE III—TREATMENT AND LATE RESULTS IN 10 CASES (NEUMUELLER AND ORATOR)

Method	Healed	E (E)	E (E)	E (E)	Rec	Time
B L	5	?	—	?	3	—
E n	3	?	?	?	—	—
C t u	—	—	—	?	—	—
pr u	—	—	—	—	—	—
N	—	—	—	—	8	—

the dorsal aspect of the wrist and in the popliteal region they are apt to be largest and in two of our cases the swelling was 6 centimeter in diameter. The smallest ganglia occur on the flexor tendon sheaths of the hand where they attain the size of a millet seed or split pea. The swelling may be visibly multilocular (Fig. 1) but most frequently it is rounded not attached to skin but most commonly attached to the deeper structures. Some ganglia are almost invisible and very difficult to palpate especially if they have not yet separated tendons. A ganglion on the dorsal surface of the wrist is accentuated by flexion and *ice versa* one on the volar surface by extension. Most ganglia are very tense a few fluctuant and some vary in consistency. It is safe to predict attachment of a ganglion to the capsule of a joint if the tenderness is marked. Close relationship with a nerve or blood vessel may also cause marked tenderness. However ganglia which are attached only to flexor tendon sheaths of the fingers are generally quite tender.

Röntgenograms give no additional information except to show in some instances a shadow in the soft parts.

A differential diagnosis must be made from tuberculosis of the joint or tendon sheath lipoma myxoma sarcoma fibroma bursitis osteoma and aneurism.

#### TREATMENT AND PROGNOSIS

We believe that the treatment should be non operative in all cases except those in which this therapy has failed and in which there are persistent troublesome symptoms or

TABLE IV—TREATMENT AND LATE RESULTS IN 170 CASES (KULTNER)

Method	Healed	E (E)	E (E)	E (E)	Rec	Time
Puncture	?	?	?	?	57	—
Breaking	?	—	—	?	50	—
Subcutaneous	?	?	?	?	36	—
Excision	?	?	—	?	3	—
N	?	?	?	?	6	—

deformity. The foregoing is based on a late follow up of 70 of our cases. The types of therapy have been noted in the analysis. It is probable that complete operative removal of a ganglion will not be followed by a reappearance. We have reason to believe that in our operative cases in which there was reappearance the removal of the cyst wall had been incomplete. This indicates the absolute necessity of careful technique under strict asepsis and under a general anæsthetic and the use of a tourniquet in order to produce a bloodless field. Prolongations of the cyst wall must be followed until they are removed completely. Nor should any so called pedicle be tied off. Careful hemostasis should be insured. In the event of accidental entry into a joint closure of the capsule over the opening is not necessary. A firm bandage over the wound tends to minimize the chance of formation of a hæmatoma from an oozing capsule. Infection will not only cause potential danger from spread along fascial planes or tendon sheaths but will prolong the postoperative course and produce an ugly scar.

Cases receiving no treatment occasionally give a definite history of spontaneous disappearance of the ganglion. This is corroborated by physical examination. Out of 12 cases followed in this group 7 ganglia disappeared. We have the assurance of two doctors who had ganglia of the dorsal surfaces of the wrists that these disappeared spontaneously. Some years ago one of us (L. C.)

observed a ganglion on the ulnar volar aspect of the wrist which disappeared in about 3 years. There are several possibilities that might account for this phenomenon for instance, the ganglion might be ruptured by a trauma which was not noticed or degeneration might cease with subsequent absorption of the mucin.

Ganglia which are broken by gradual pressure of the fingers or a sudden blow may never reappear as shown by 7 of the 9 cases followed in this group. As a rule those ganglia connected only with tendon sheaths are easily broken. It may be impossible however to break those which subsequently prove to be attached to the capsule of a joint which have a thick connective tissue wall and which are well protected by soft parts. It is this type which is almost always tender probably from pressure on the nerves and blood vessels of the capsule. The expressed contents of the ganglion are probably absorbed and there is subsequent agglutination of the cyst walls. There are others on the contrary which refill the cyst cavity with mucin thus causing a re appearance of the ganglion.

Aspiration of the contents of a ganglion with injection of an irritant such as tincture of iodine or carbolic acid gave good results in 6 of the 8 followed cases. This treatment should be followed by a pressure bandage and is especially indicated in those ganglia which cannot be broken and are troublesome.

Stripping, baking and massage probably produce the same type of trauma as pressure and are not to be recommended because other methods of treatment are more effective.

#### SUMMARY

1 We believe that ganglia are cysts resulting from mucinous degeneration of connective tissue. They occur generally in or are attached to capsules of joints or tendon sheaths but do not communicate primarily with joints or sheath spaces.

2 The degeneration proceeds with fibrillation of the collagen fibers and accumulation of mucin both within the cells and in the intercellular spaces. This results finally in the disappearance of cells and fibers in a number

of adjacent areas. These embryonic cysts coalesce and lead to the formation of larger cavities. The cause of this degeneration still remains obscure but it is probably not due to any lack of vascular supply. Although there is evidence of cell proliferation we are not of the opinion that ganglia are neoplasms.

3 They occur most frequently about the wrist joint, volar surfaces of fingers, dorsum of foot and popliteal region. Ganglia are most frequently found in females of slight build in the second, third and fourth decades. We are not convinced that trauma plays a major rôle in their production.

4 The chief symptoms and signs are swelling, pain, interference with function and tenderness.

5 A differential diagnosis must be made from tuberculosis of the joint or tendon sheath, lipoma, myxoma, fibroma, osteoma, sarcoma, bursitis and neurinoma.

6 Late results after various therapeutic measures have convinced us of the advisability of non operative treatment. So many ganglia disappear spontaneously and after breaking and pressure, aspiration and pressure or aspiration with injection of a chemical irritant and pressure that operative therapy should be recommended only when non operative treatment has failed and when there are persistent troublesome symptoms, signs or deformity. Careful complete excision of ganglia under strict asepsis and with a bloodless field will probably not be followed by reappearances.

#### BIBLIOGRAPHY

- 1 BILLROTH THEODOR. Die Allgemeine chirurgische Pathologie und Therapie. Berlin: G. Reimer, 1888, p. 689.
- 2 BORCHARDT. Zur Pathogenese der Ganglien. Deutsche medizinische Wochenschrift, 1900, xxvi, 254.
- 3 CLARKE WILLIAM COGSWELL. The pathogenesis of ganglia with a description of the structure and development of synovial membrane. Surg. Gynec. & Obst., 1908, vi, 56.
- 4 ILLER J. Position Anatomique de l'Origine et de la Formation du Ganglion. Histoire de l'Académie Royale des Sciences et de Belles Lettres de Berlin, 1746, II, 108, 114.
- 5 FLOEDRUS. Studien in der Biologie der Skelettorgane mit besonderer Berücksichtigung der Entstehung der histoiden Gelenkverwachsungen. Berlin: Friedländer u. Sohn, 1913. Quoted by Kuettner and Hertel.





ULCER CRURIS THE ETIOLOGY, PATHOGENESIS, AND TREATMENT<sup>1</sup>

By H O MCPHEETERS M D F A C S MINNEAPOLIS MINNESOTA

ULCER cruris or the more commonly known varicose ulcer may be one of the most severe and disabling conditions of the lower extremity. Individuals so afflicted are truly victims and even though healing is successful they must endure their disability for the rest of their lives with a fear of a recurrence of the ulceration.

The etiology is now very generally accepted to be a trophoneurotic disturbance and condition resulting secondarily to the development of varicose veins. Since the varicose condition of the veins with the resultant stagnation of fluid in the tissues is the basic factor producing the ulcerations we must first discuss the etiology of varicose veins.

The normal flow of blood from the foot is upward through the deep set of veins located among the muscles of the leg and the superficial veins in the fatty tissue just under the skin. The flow upward is accelerated (1) by the contraction of the muscles of the calf while walking and (2) by the aspiratory effect of respiration. The latter has often been denied yet it can be seen and has been experimentally proved. This aspiration is in two phases: (a) from the upper extremity during inspiration and (b) from the lower extremity during expiration. Inspiration increases the negative pressure in the chest yet increases the positive pressure in the abdomen and vessels below the diaphragm. Expiration with the diaphragm rising produces an aspiration with a negative pressure below the diaphragm assisting the upward flow of blood in the veins of the extremities. This back pressure during inspiration acting on the valves in the femoral and saphenous veins at the saphenofemoral junction aids the reflux flow of blood in the superficial set of veins.

Back pressure is further increased by the intra abdominal pressure from heavy lifting. It is increased by pregnancy with its mechanical obstruction as well as the great increase in blood volume supplied to the iliac vein by the greater vascularity of the uterus (Kowatzki and Lochr).

In addition to these causative factors we have conflicting theories regarding other factors. Sicard of the University of Paris believes that the condition can best be explained by a lack or absence of the endocrine functions of the ovary. Kashamura the Japanese surgeon believes that they are entirely due to the loss of the neuromuscular tone of the vein wall. Von Meisen of Copenhagen believes varicose veins are associated with a general weakness of the connective tissue structure of the body and accompany such pathological states as flat feet, entropsis, varicocele, etc. Schrambacher and Lederhose believe that there is a congenital weakness of the vein walls. Bregman believes that there is an angiosclerosis and phlebosclerosis similar to that of arteriosclerosis as the primary factor. Zinser and Philip both believe that syphilis plays a factor in a larger percentage of the cases than we have thought. Some authorities notably Fischer, Nobl, Renzi, Hesse and Schaak believe that the condition is best explained on the theory and basis of a former infection involving the vein wall and probably embolic in nature. This would account for the multiple segments of veins involved better than any other explanation. I am firmly convinced that the great majority of cases can best be explained by the infection theory with heredity as a predisposing factor.

As a result of various causes the veins lose their power of carrying the venous blood to the heart and become dilated and filled with stagnate blood. Sooner or later the difference in pressure between the blood in the veins and the fluid in the tissues is equalized. Then by the process of stasis the tissues become waterlogged and their resistance to infection or trauma becomes lowered because of impaired nutrition. As a result an ideal condition for the development of the varicose ulcer is produced. Figure 1 is self explanatory of this condition as it shows complete loss of valve function in superficial and communicating veins and the association of venous blood with tissue saturation.

The immediate cause of the tissue break down is often trivial. It may be embolic and due to infected teeth, tonsils, hemorrhoids, etc. or as frequently happens it may result from light trauma and terminate in local necrosis. If not cared for the affected veins may increase in size and number, the congestion may increase, the ulcer may penetrate deeper and may result in a painful perioditis of the tibia. However the process may be limited and cured by prompt efficient treatment although the ulcer cycle always causes much damage to the circulation and nutrition of the tissue and leaves the tissue far more susceptible to ulceration. Ultimately following many years of ulceration and healing, the tissues become so indurated that a continuous potential state of gangrene exists and ulceration can be prevented only with the help of external support.

#### PATHOLOGY

The actual ulceration begins with a gangrene and separation of the superficial layers of the skin. At times the area takes on the typical appearance of a carbuncle while in other cases it is a result of a long standing condition the ulceration extends through all of the dermal layers. In some cases the whole lower leg has the appearance of an extensive far advanced weeping eczema.

Microscopic sections through the ulceration demonstrate that the pathology is largely in the skin and that there is only an inflammatory reaction of the tissue beneath.

Bacteriologic examination of the ulcers has proved that there is no constant organism that may be held as a specific cause. The staphylococcus and streptococcus are found in all cases and are usually associated with other organisms. In no instance regardless of the severity of the case has the *Ga. bacillus* or *bacillus* of gangrene been found. Professor Gabor Nobl states that he does not believe that there is any relation between the type of infection or bacteria in the ulcerating area and the slowness or rapidity with which the ulcer heals. His opinion was confirmed by the extensive work of Lowenfeld on the *Bacteriology of Varicose Ulcers* which shows that those ulcers which heal most rapidly often

contain the most bacteria. My experience confirms this opinion.

#### DIFFERENTIAL DIAGNOSIS

In discussing the differential diagnosis of varicose ulcers we must consider the syphilitic, the tuberculous, the rodent (malignant) and the rarer forms of ulcerating conditions of which the most common would be actinomycosis.

1. *Varicose ulcers* are by far the most common ulcerating condition of the lower extremities and are of all sizes, shapes, and conditions. Associated with the ulcer there is usually a well marked area of inflammatory reaction which at times will spread for several inches beyond the open ulcer. The ulcer as well as the surrounding tissue may be very tender. The edges are usually sloping in appearance and the base is ordinarily covered with large coarse granulations and a grayish exudate. The discharge may be very profuse. As already stated the dilated varicose veins with their reflux flow and accompanying congestion are accepted as being the cause of the varicose ulcer. One can nearly always find the large venous channels about the ulcerating area. Sometimes the veins lead directly into and under the ulcer and in the case of a very positive diagnosis can be made (Figs. 2 to 7 inclusive).

2. *The syphilitic ulcer* usually has punched out sharply defined edges which at times are raised. It is ordinarily deeper than ulcers arising from other causes. The base is dark red and has large granulations which may be unusually large in the larger ulcers and may bleed very readily. Much serum exudes from the surface but this does not give the impression of being pus. Luetic ulcers may assume any shape or condition. In addition to the clinical appearance a positive Wassermann is present and often a history of the original infection is obtained.

3. *The tuberculous ulcer* is uncommon on the lower extremities. The edges are usually undermined. Some authors state it has a tendency to progress with an irregular border outline giving the impression at times of a half circle but this is not a tuberculosis characteristic. The base is seldom red and granu-

lating as in the luetic ulcer but more frequently is covered with a grayish necrotic exudate. It is thought that the tuberculous ulcer is always secondary to tuberculosis else where. An active tuberculosis would of course be a definite diagnostic sign.

4 *The rodent or malignant ulcers* are infrequent on the lower extremities although common elsewhere they are found in older patients and do not have the local inflammatory reaction which is seen with varicose ulcers. There would be no varicose veins except as a coincidence and there would be no response to the usual treatment. With a negative Wassermann no symptoms or signs of tuberculosis and with no response to the usual ulcer treatment a biopsy should be made to confirm the diagnosis.

5 *Trophic ulcers* can usually be diagnosed without difficulty after consideration of the clinical history of the case.

6 *The actinomycotic ulcer* starts as a nodule subsequently breaking down leaving a necrotic base with scattered yellowish nodules. This type of ulcer is very rare and is seldom seen except in hide handlers etc. The diagnosis would be suspected when cure had resisted all treatment. Curettings should be made from the ulcer base with examinations for the ray fungus.

#### TREATMENT

The results of treatment of ulcer cruris have always been unsatisfactory. Ointments and lotions are legion and include those used by the Indian healers, the miracle men, the professional quacks and those employed today by the profession. Silver nitrate is by far the most efficient of all although any ointment supported by a bandage may prove useful. The Unna cast is I believe the most efficient.

Boynton's adhesive strapping for support directly over the ulcer has many advocates and is often efficient due to its support of and pressure on the granulating surface.

Pondorf favors the vaccine treatment. It is believed that an autovaccine made from the organisms infecting the ulcer area is of much value. Li de Gaetano and several other authorities on the subject believe that the results obtained following the use of Boynton's

adhesive strapping or with the Unna cast are due in large measure to the softening of the tissues by the continued local bathing by the secretions of the ulcer with a secondary reabsorption and autoaccination from the bacteria present. It is probable that such is actually the case and that this is a large factor in the good recovery obtained in some of the extreme cases.

In the past the surgeon has felt that operation is necessary and has devised all sorts of procedures having as their goal the correction of the defective circulation. A common operation is the Schede multiple circular incision. The surgeon here attempts to cut and ligate all vessels of the offending and superficial group of veins. Babcock advised stripping the main vein with his specially devised stripper. Charles Mayo improved on this and today his is a popular method and has frequently given good results. Some raise the fat from the deep fascia from one Schede incision to another thus hoping to break all the communicating veins. This is efficient if there is only a plexus present but if the condition is extensive and scattered it is almost useless. Other surgeons have made long incisions from groin to ankle removing the long saphenous with its side branches but an unsightly scar results and recurrences have been frequent. Some have made circular incisions about the ulcer hoping to break all venous supply. These methods entail preliminary bed rest with elevation for the badly infected cases. Operation is contra indicated until the condition is brought under control.

The injection of sclerosing solutions is the most modern and efficient method of treatment when the veins are the chief cause of the ulcers. It accomplishes better and more thorough results than the operative treatment and has the added advantage of not necessitating hospitalization, anesthetization, bed rest, loss of time from work, risk of infection and extensive operative incisions. When the proper technique is employed no disfiguring scars follow this treatment and there is less danger of embolus than from operative procedures. The injection treatment can be started at once in cases of badly infected ulcers and the results are thereby hastened.

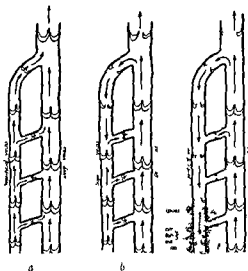


Fig. 8. Venous flow in the leg. 1. The leg. 2. The ulcer. 3. The catheter. 4. The solution. 5. The bandage. 6. The dressing. 7. The cast. 8. The result.

The technique of the injection is simple and follows the method of Linser, Sicard, Nobl and von Meisen. I have added the use of a tourniquet so that temporarily the solution will be retained locally and the sclerosing effect will be insured. I use a 20 per cent salt solution for all extensive cases, the 60 per cent and 76 per cent calorse for the isolated varix which is often left after the use of the salt injection or in cases in which there is one long vein with a distinct positive Trendelenburg and the 30 per cent and 40 per cent sodium salicylate in the occasional case that does not respond to salt or calorse. I have used 1 per cent mercuric chloride in 3 cases during the past year because the veins resisted the sclerosing effect of other solutions. For each solution there is a definite indication and a definite characteristic reaction, some reactions being more extensive than others. The most important point in the technique is that the injection *must always be within the lumen of the vein*. This is absolutely imperative in order to avoid sloughs and complications. With the proper technique and proper choice of solution the ideal results are obtained (Figs 8, 9, 10).

When the affected veins have been destroyed and the circulation has been corrected the ulcer heals quickly under routine treatment. This is accomplished by the method of

Rodolfo Klapp of the Clinic of Berlin with the additional use of a large rubber sponge as advised by Professor Nobl. In the case of large ulcers skin grafts are made at the proper time. The rubber sponge aids in giving the needed support to the leg and by elastic compression forces the excess fluid from the tissues at the same time removing the continued stagnation of fluid in the ulcer area. The method now used is as follows:

1. Inject and sclerose all veins as fast as they can be found.
2. Apply silver nitrate locally, the strength of the solution depending on the type of granulations present.
3. Cut a good grade of rubber bath sponge so as to cover 1 inch beyond the edge of the ulcer.
4. Cover the ulcer with gauze fluffed for better absorption.
5. Apply the cut rubber sponge over the ulcer.
6. Cover all with two layers of glazed cotton wadding which is impervious to the discharge and helps keep the bandage clean.
7. Bandage the leg with a good grade of cotton elastic bandage similar to the Ace and preferably 4 inches in width. This is put on from knee to toes and as tightly as it can be wrapped.
8. Change dressings every 2 to 3 days as needed for comfort and care of the discharge.
9. Continue the rubber sponge pressure until the ulcer has completely healed.
10. At the proper time judicious use of skin grafting will very materially shorten the period of healing. This however should not be done until after careful and complete sclerosing of all the offending veins and complete elimination of the lymphangitis and extensive tissue infection about the ulcer have been effected. The ulcer bed should be carefully prepared as for any skin graft.

11. In all cases as soon as the ulcers have healed put on an Unna cast for continued support. This is most essential in cases in which skin grafts have been made and must be applied before the patient leaves the bed. Change this cast every 2 weeks at first and then every 3 to 4 weeks. In all extensive cases this must be continued for a long time either



Fig 1

Fig 3

Fig 4



Fig 5

Fig 6

Fig 7

FIGS. 5 to 7 Showing the intimate relation of vein to the ulcer. In Fig 6 is shown a fungus infection of eczematoid ringworm on the foot and leg which often complicate the ulceration.

by casts bandage or the elastic and rubber stockings. In some cases the patient needs this support the rest of his life in order to avoid a recurrence.

Many men have associated calcium imbalance with ulcer formation but so far attempts to correct this have failed. I believe that the use of the average parathyroid extract by mouth is useless. Of late I have been using parathion hypodermically twice a day. This is thought to be the active hormone of the parathyroid gland prepared according to the technique of Dr. Adolph Hanson of Fairbault, Minnesota. The cases as yet are too few to report but blood calcium checks show a marked increase of calcium content under its use and I feel that the cases have responded more rapidly than have cases in which it has not been employed.

#### COMPLICATIONS

1. *Complications associated with the ulcerating condition itself.* a. The most common complication associated with varicose ulcers aside from the coincident phlebitis and lymphangitis locally is a pruritis which at times extends over the whole lower leg. This at times is very resistant to treatment and frequently recurs. It is best cared for by two applications each day of Burroughs solution diluted 1 to 10. This is a solution of aluminum acetate plus a small amount of acetic acid. Some advise the use of the aluminum subacetate in an 8 per cent solution and then diluted 1 ounce with 500 cubic centimeters of water. This is applied in the form of continuous wet packs.

b. A fungus infection similar to what Strickler calls eczematoid ringworm and caused by the epidermophyton fungus. This

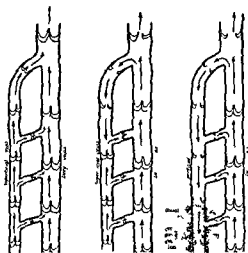


Fig. 1. Normal flow in superficial and deep veins.  
 b. b. g. n. g. f. n. superficial. c. complete. s. f.  
 l. e. f. u. n. t. i. o. n. s. u. p. e. r. f. i. c. i. a. l. d. m. m. u. n. a. t. g. e. n. s.

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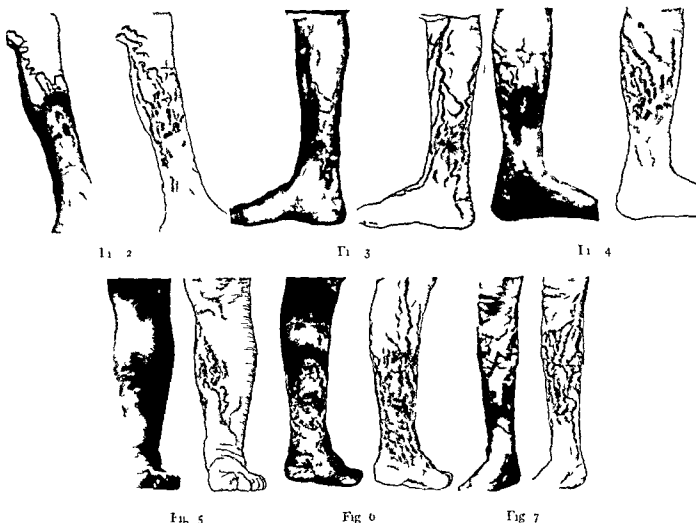
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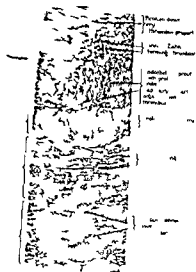
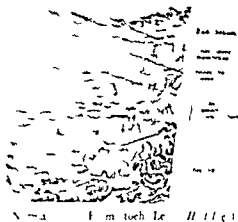
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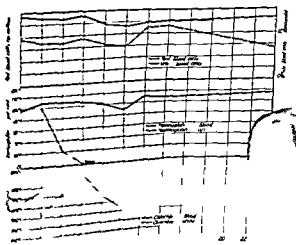




the tough cornified skin near the heel, the foot and between the toes. At the whole skin will form large very tender painful blebs filled with a translucent fluid. In extreme cases the tough skin becomes whitened and macerated and will peel off in large areas leaving a secondary infected base. This condition is also best treated by the Burroughs solution. At times it is very resistant and must be treated persistently and frantically with some ointment such as Whitefield ointment. This is a preparation of salicylic acid and benzoic acid and has a marked keratolytic effect. Recurrences are common.

1. go T t d v l h l st flt t wt  
l gn g gv t f th tl ml f ll p p  
t sod um hl l j t

2. Complications associated with the injection treatment. a. If perivascular injections are carelessly made a slough will occur especially when the salt the sodium salicylate or the bichloride solution is used. It is not so constant or severe with the calomel of Nobl or



1 (f)

7



Fig 13

Fig 14

Fig 15

Figs 13 and 14 Mrs C Showing condition before and after treatment

Fig 15 Mr I W Showing condition before and after treatment

any of the sugar solutions. If a perivenous or extravenous injection has been made the first and immediate sensation will be a severe burning at the point of injection. Three or 4 minutes later a definite circumscribed *blanched patch* will appear. Within 10 or 15 minutes this patch assumes very definitely circumscribed *bluish gray* discoloration. This is absolutely pathognomonic of an extravenous infiltration of the salt solution. If the infiltration has been made more deeply this sign will

not appear until later and the burning sensation must be considered sufficient evidence to institute corrective treatment. If this is allowed to go untreated for 24 hours this patch will have assumed a bluish black discoloration with the formation of a large vesicle over the entire area. Following this there results a dry gangrene which terminates in a slowly healing ulcer. Extensive infiltration of the area with normal saline at the first indication of this sign so as to care for the excess salt



Fig 16

Fig 17

Fig 18

Fig 19

Fig 20

Fig 21

Fig 22

Fig 23

Fig 16 John D Varicose veins and ulcer before treatment December 2 1922

Fig 17 John D Varicose ulcer after treatment January 30 1928

Figs 18 and 19 Mr A W Varicose ulcers and healed

Fig 20 Frank P Varicose ulcer before treatment August 4 1927

Fig 21 Frank P Varicose veins and ulcer after treatment January 31 1928

Fig 22 Frank S Varicose ulcer before treatment November 8 1917

Fig 23 Frank S Varicose ulcer after treatment by means of vein injection and secondary skin graft January 31 1928



Fig. 1. (Left) S. M. I. V. (Right) S. M. I. V. (Left) S. M. I. V. (Right) S. M. I. V.

injected will add the tubercle and eliminate a very distinct lymphatic which with proper technique should not occur. This is a positive characteristic of infection resulting from a perivascular injection of 10 percent solution in the preventable by an extensive infiltration of normal saline in the involved area. Sterile water has been employed for this condition but gives greater pain and a more extensive reaction during the following 48 hours. A similar reaction develops following a previous injection of calcium chloride or bichloride of mercury. The injection of normal saline however does not prevent the development of the slough and gangrene when these solutions are used. When a sloughing gangrenous area does develop it is best treated by surgical removal 24 hours following the injection. The tissues are then brought together by an immediate closure and primary suture. The edges should be reinforced both by suture and adhesive strapping. This procedure however should be done under the most meticulous aseptic conditions. I attempted this in one case at the dispensary where we were not prepared to do major surgery and unfortunately a streptococcal infection resulted and later developed into a streptococcal septicemia followed by death of the patient.

b. Ascending chemical phlebitis at times occurs following injection. I believe this can be explained by the fact that the communicating valves function normally and the reaction of the injected tissues merely proceeds up the saphenous vein to the saphenofemoral junction.

Similar to the closed end of a water pipe. However this is exactly what I wish to have occur and the condition no longer causes any concern. If it were an infectious thrombophlebitis then I would worry but as long as I feel that my technique has been perfect and no infection has occurred I am happy to have this finding. When infectious thrombophlebitis does occur however the thigh should be supported by strappings of 4 inch strip of adhesive so as to make the patient more comfortable and to help quiet the reaction.

c. True staphylococcus infection with abscess formation at the site of the injection and in the large loop may occur as the result of inefficient sterilization at the site of injection or extensive infection through the tissue from a sloughing ulcer. The latter complication however can be avoided and with the proper decision and technique at the time of the operation should not occur. The infections are very tender and must be opened and drained. Large hot wet packs applied to the infected area quiet the painful condition quickly.

This report is based on the care and treatment of 348 cases of varicose veins of which 65 have had ulcerating complication.

#### SUMMARY AND CONCLUSIONS

1. Ulcer crum is the end result of the trophic neurotic disturbance in the leg and foot resultant from the stagnation of blood serum in the tissue secondary to varicose vein.

The attempt to cure the ulcer first and the veins second is wrong both in theory and practice.

3. The varicose veins are obliterated far better by the injection treatment than by operation.

4. The supportive bandage for the affected extremity with the rubber sponge pressure over the ulceration is the oldest and yet the most efficient treatment of the present day.

5. Judicious employment of the skin graft at the proper time greatly shortens the period of healing.

6. All the long standing case with extensive involvement must have continued support for long periods of time to avoid recurrence.

The duration and extent of the support must be decided in each individual case

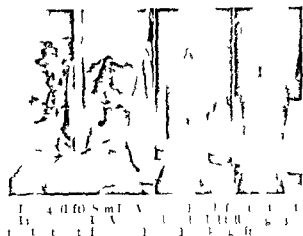
8 Finally by the use of the described technique all varicose ulcers can be healed and kept healed. If they cannot it means that the operator has not been keen enough to locate the vein which causes the condition and which is often under the ulcer bed or that he has been negligent in giving the extremity the necessary lasting support

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# BIBLIOGRAPHY<sup>1</sup>

- BEFTWISTLE A P Treatment of chronic varicose ulcer *Brit M J* 19 6 1 139
- BIANCHI I The treatment of ulcer of the legs and varices *Rev med de la Suisse Rom* 1913 lvi 1-160
- DAVIS R H A new application for varicose ulcers *Arch Dermat & Syph* 1926 n s xli 3 9-21
- 4 CROFT W R and VINTS H W C The etiology and treatment of varicose ulcers *Brit M J* 19 1 11 68-689
- HAYES J M Treatment of varicose ulcers *Tr Ass Resident & ex Resident Physicians Mayo Clin* 1923-1926 vi 2-132
- 6 FRIDMAN E Etiology pathogenesis and histological structure of varices *Frankfurt Ztschr f Path* 1925 xciii 300-326
- 1 Iddit f es l d w th my f m p p e
- 7 LINER K Treatment of varicose veins with local injection of 15-25 per cent sodium chlorid solution varicophin *Dermat Wchnschr* 19 5 lxxvi 1345-1351
- 8 LOEWENFELD W The bacterial flora of varicose ulcers of the leg (Zur Bakterienflora des varicosen Ulcus cruris) *Wien klin Wchnschr* 1924 xxvii 502
- 9 MCKNIGHT H A A new method of treatment for varicose ulcers of the leg *J Am M A s* 1921 lxxii 1890
- 10 McHEETERS H O The injection treatment of varicose veins by the use of sclerosing solution *Surg Gynec & Obst* 19 7 xlv 541
- 11 Idem The modern treatment of varicose ulcers *J Lancet* 1928 xlviii 189
- 12 NOBL C Druckbehandlung von Stauungsgechueren (Pressure treatment of varicose ulcer) *Wien klin Wchnschr* 1924 xxvii 644-646
- 13 PASIOR JCSE Obliterating treatment of varicose ulcers of the legs *Rev de an mil y med mil e pan* 1926 xvi 233-237
- 14 ROBINSON C A Notes on 20 cases of ulcer of leg treated by electrical methods *Arch Radol & Electroth* 1922 xxvi 253-257
- 15 SICARD J A and CAUGHER L Treatment of varicose by sclerosis inducing injections (sodium salicylate and other) *Pre e med* 1926 xxxiv 689-693
- 16 SICARD J A PARAF J and FOKESTIER J Le traitement de varices par les injections intravariqueuses de carbonate de soude *J med franc* 1921 x 37-384
- 17 STEEL W Treatment of varicose leg ulcer *Internit Clin* 19 2 ix 9-301
- 18 TWISSMAN E D A varicose veins and ulcers inoperable remain on the anatomy *Surg Clin N Am* 1923 iii 1663-1666
- 19 WALTER Treatment of varicose veins and ulcer *Munchen Med Wchnschr* 19 5 lxxii 12



injected will kill the bacteria and eliminate a very distressing complication which with proper technique should not occur. This is a positive characteristic condition resulting from a pericardial injection of 10 per cent salt solution and is prevented by an extensive infiltration of normal saline in the involved area. Sterile water has been employed for this condition but is very painful and a more extensive reaction during the following 48 hours. A similar reaction develops following a perivascular injection of sodium salicylate or bichloride of mercury. The injection of normal saline however does not prevent the development of the ulcer and infection when the solution is used. When a sloughing gangrenous area does develop it is best treated by surgical removal 4 hours following the injection. The tissue is then brought to either by an immediate closure and primary suture. The edge should be reinforced both by suture and adhesive strapping. This procedure however should be done under the most meticulous aseptic conditions. I attempted this in one case at the dispensary where we were not prepared to do major surgery and unfortunately a streptococcal viridans infection resulted and later developed into a streptococcal septicemia followed by death of the patient.

b. Ascending chemical phlebitis at times occurs following injection. I believe this can be explained by the fact that the communicating valves function normally and the reaction of the injected tissues merely proceeds up the saphenous vein to the saphenofemoral junction.

Similar to the closed end of a water pipe. However, this is exactly what I wish to have occur and the condition no longer causes any concern. If it were an infectious thrombophlebitis then I would worry but as long as I feel that my technique has been perfect and no infection has occurred I am happy to have this finding. When infectious thrombophlebitis does occur however the thigh should be supported by strapping of 4 inch strips of adhesive so as to make the patient more comfortable and to help quiet the reaction.

c. True staphylococcal infection with abscess formation at the site of the injection and in the large loops may occur as the result of inefficient sterilization at the site of injection or extensive infection through the tissue from a sloughing ulcer. The two latter complications however can be avoided and with the proper decision and technique at the time of the operation should not occur. The infections are very tender and must be opened and drained. Large hot wet packs applied to the infected area quiet the painful condition quickly.

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#### SUMMARY AND CONCLUSIONS

1. Ulcer cruris is the end result of the trophoneurotic disturbance in the leg and foot resultant from the stagnation of blood current in the tissue secondary to varicose vein.

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### BIBLIOGRAPHY

- 1 BERTWISTLE A P Treatment of chronic varicose ulcer Brit M J 19 6 1 139
- 2 BLANCHARD I The treatment of ulcers of the legs and varices Rev med de la Suisse Rom 1923 xliii 155-160
- 3 DAVIS R H A new application for varicose ulcers Arch Dermat & Syph 1926 n s iii 10-32
- 4 CROVEY W R and VINES H W C The etiology and treatment of varicose ulcers Brit M J 1921 i 68-689
- 5 HAYES J M Treatment of varicose ulcers Tr Ass Resident & ex Resident Physicians Mayo Clin 19 5-1926 vi 127-132
- 6 FIFMAN F Etiology pathogenesis and histological structure of varices Frankfurt Ztschr f Path 1925 xx iii 300-326

- LINSER K Treatment of varicose veins with local injection of 1-5 per cent sodium chlorid solution varicophatin Dermat Wchnschr 1925 lxxxi 1345-1351
- 8 LOEWENFELD W The bacterial flora of varicose ulcers of the leg (Zur Bakterienflora des varicosen Ulcus cruris) Wien klin Wchnschr 1924 xxx ii 502
- 9 MCKNIGHT H A A new method of treatment for varicose ulcers of the leg J Am M Ass 1921 lxxvii 1890
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- 12 NOBL G Druckbehandlung von Stauungsgechvieren (Pre-sure treatment of varicose ulcer) Wien klin Wchnschr 1924 xx ii 644-646
- 13 PASTOR JOSE Obliterating treatment of varicose ulcer of the leg Re de an mil y med mil e pan 1926 xvi 33-237
- 14 ROBINSON C A Notes on 20 cases of ulcer of leg treated by electrical methods Arch Radol & Electroth 19 23 53-5
- 5 SICARD J A and GAUCIER L Treatment of varicose by sclerosing inducing injections (odium salicylate and others) Presse med 1926 xxxiv 689-693 Abstracted in J Am M Ass 1926 lxxvii 283
- 16 SICARD J A IARAF J and FORESTIER J Le traitement des varices par les injections intravariqueuses de carbonate de soude J med franc 1921 x 37-384
- 17 STELL W Treatment of varicose leg ulcer Int n Clin 1921 i 29-301
- 8 TWAMAN F D Varicose veins and ulcerable marks on the anatomy Surg Clin N Am 1923 iii 1663-1666
- 10 WALTER Treatment of varicose vein and ulcer Muenchen med Wchnschr 19 5 lxxvii 1

Added to the list of the following

## ACUTE THYROIDITIS

## A STUDY OF SIXTY SEVEN CASES

B E C BURHANS B S M D P I L A D L I A  
D p m f g l f p y l c d h o n l

ACUTE thyroiditis with or without abscess formation occurs commonly enough to warrant careful study so that its presence may be diagnosed and proper treatment instituted. Although it is regarded as a rare occurrence by many authors I have found over 200 cases reported in the literature. Robertson (33) in 1911 reported 96 cases. Hagenbuch (10) in 1911 reported 43 cases and I have selected 67 out of over 80 cases which have occurred or have been reported during the last decade. Furthermore many of our clinicians do not find time to record their experiences in literature so that the tendency is for only a minor proportion of cases of any disease to be published. In this be true acute thyroiditis is not a rare a malady as the medical profession has been wont to believe.

My attention was first drawn to this disease when I was called upon to treat the following case. I report the matter here in detail because it has many interesting features which will be discussed later in this paper and because it is only fair to future students that concise but accurate case reports be given so that those wishing to accumulate data can have material with which to work.

The patient was a female aged 77 years who complained of a painful swelling the neck. For many years she had had a small lump in the lower part of the neck about in the middle of the thyroid isthmus. This had not caused symptoms until 5 days before admission to the hospital when it began to enlarge and become painful. The swelling spread to the right side of the neck and the parathyroid glands to the ear. Turpentine poultices were applied but did not give relief. The swelling became more marked but there was no tracheal with respiration or deglutition no cough and no hoarseness. There were no symptoms of hyperthyroidism or hypothyroidism. Twelve hours before admission the patient had had a head cold and pharyngitis. Otherwise the cardiorespiratory history was negative. The gastrointestinal history was also negative. The patient had suffered from frequency and no turgor for some time but there

was no burning hæmaturia or pyuria. She complained of polydipsia. Her family history was negative for thyroid disturbance.

Physical examination revealed a poorly nourished elderly woman with a red swelling 5 centimeters in diameter low down in the neck anterior in the midline. The tumor was slightly tender and tense and gave a sensation of fluctuation. The process seemed to extend into both lobes of the thyroid gland particularly the right lobe. There was posterior displacement of the large vessel on the right side. Swallowing was easy and painless and caused the swelling to move anteriorly but not up and down. There was no exophthalmos. Examination of the chest and abdomen was negative. There was no tenderness of the extremities no tremor of the hands. Coloration of the skin no bone tenderness. Reflexes were normal. Temperature 99.8 degrees Fahrenheit and respiration 6. The blood count showed 4,050,000 red blood cells, 3 per cent hæmoglobin, 18,000 leucocytes and 87 per cent polymorphonuclears. The urinalysis showed a heavy load of sugar no acetone and a total acid 32.6 milligrams per cent blood sugar 217 milligrams per cent blood urea. The basal metabolism was plus 33.

Diagnosis of acute thyroiditis with suppuration and drainage was made.

Antiseptics were applied for the night. In the morning the patient had severe paroxysmal dyspnea and a heavy load of respiration and was coughing up small amounts of bloody mucus. There was pain on swallowing.

Operative under novocain local anesthesia was performed at once. A small transverse incision was made over the swelling in the midline. After the skin and subcutaneous tissues had been opened an exploratory puncture was made and a thin serosanguinous fluid was obtained. The transverse incision was then extended the anterior plane of the deep fascia was split longitudinally and the sternothyroid and sternohyoid muscles were retracted laterally exposing an abscess wall. This was opened and quantity of blood serum burst forth under pressure followed by thick yellow pus. The abscess cavity was found to extend out to the deep vessels on either side. One rubber drain was inserted. Culture showed the presence of staphylococcus aureus.

The convalescence was long and stormy. The diabetic condition was hard to control in spite of the fact that the wound was draining freely. One week after the operation the patient developed an erysipelas of the face the process apparently starting near the draining sinus and extending up



Fig 1 Tissue removed at operation showing necrosis of glandular tissue with some colloid still present in the degenerated acini



Fig 2 Photomicrograph of the diseased thyroid tissue removed at operation. The necrosis of the tissue is marked, but only the presence of colloid makes a diagnosis possible. High power

over the nose and cheeks. The sinus drained a great deal of pus. Ten days later the erysipelas had cleared up, the sinus was still draining pus and the diabetic condition was fairly well under control. Two days later, however, the patient developed a chill and the temperature rose to 103 degrees. A bloody diarrhoea started and lasted for 2 days. The patient complained of pain in the left knee over the suprapatellar bursal region. This bursa became red and swollen and aspiration revealed pus due to a staphylococcus aureus infection. The bursa was incised widely. Two days later the patient developed pain in the knee joint. As the joint was red and swollen and aspiration yielded pus, an opening was made on either side under gas anaesthesia and a large quantity of thick pus was evacuated. No drainage was introduced. Willems method of active mobilization was pursued since there was no bone pathology. The joint drained freely but a week later an infrapatellar bursitis developed and was treated by free incision. The infection spread along the patellar tendon into the tibia and an osteomyelitis developed. Amputation was advised but the patient refused to permit it. Blood transfusions were given so as to build up the patient's resistance. The osteomyelitis finally spread into the femur and the patient gradually became weaker and died 3 months after the occurrence of the first attack of thyroiditis.

An autopsy was performed and the thyroid gland removed. It was found that the suppuration had occurred in an adenoma with the pus burrowing either way so that it lifted the capsule from the right and left lobe. The remaining thyroid gland was filled with adenomata and showed signs of recent inflammation. There was an osteomyelitis of the tibia, fibula and femur and a suppurative arthritis with destruction of the right knee joint. Death was due to toxemia and exhaustion.

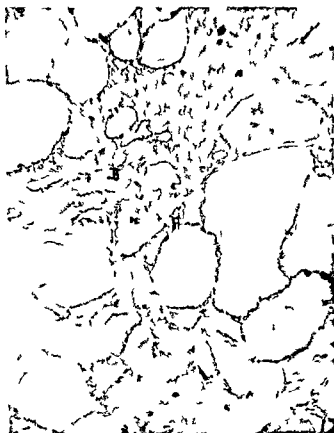
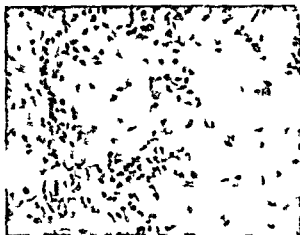
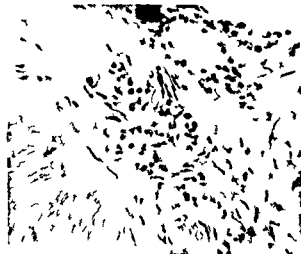


Fig 3 Thyroid tissue showing acute inflammation. There is dilatation of the capillaries, polymorphonuclear infiltration of the interstitial tissues and the acini demonstrate hemorrhage into the interstitial tissues and acinar coagulation of the colloid and all types of cell pathology ranging from cloudy swelling to complete necrosis.





I b 4 A I f m I l l l l w l o  
g t l h t l l l l b  
p l m p l u l d l l l t n Th  
l l d h l p l l l l l l l l  
A m l l l m f t l l l l  
l m m p l l l l f m t l m t m m



I b 4 A I f m I l l l l w l o  
g t l h t l l l l b  
p l m p l u l d l l l t n Th  
l l d h l p l l l l l l l l  
A m l l l m f t l l l l  
l m m p l l l l f m t l m t m m

#### ANATOMICAL FACTORS

Anatomically the thyroid gland has certain characteristic which render it resistant to infection. It is a deep seated gland well protected against external injury by heavy fascia and muscle. It has no duct along which infection may travel to reach the parenchymatous structure. Peristence of the thyroglossal duct or duct of His leading from the pyramidal lobe to the foramen cæcum does have a direct communication with the pharynx. Meeker (8) has reported a case of infection through a persistent duct. Stein (37) has reported a case of abscess of the pyramidal lobe following an upper respiratory infection. This is probably due to the spreading of infection along a persistent thyroglossal duct.

The gland has a heavy capsule formed by union of the superficial layer and the pretracheal layer and the deep fascia. It is overlaid by the sternothyroid, sternohyoid and platysma muscles anteriorly and by the sternocleidal muscle on either side. This deep fascia tend to protect the thyroid from invasion by infection in the contiguous structure, the infection being confined to its fascial compartment and traveling up and down but not through these fibrous columns. The heavy overlying fasciae and muscles tend

to make early enlargements of the thyroid and fluctuation in the thyroid difficult to ascertain.

The rich blood supply of the gland is provided by the comparatively large superior and inferior thyroid arteries. Venous drainage through the superior middle and inferior veins is free. The vascular arrangement in the gland itself consists entirely of an intricate meshwork of minute capillaries supported in a fine fiber elastic stroma. The lymph drainage is unusually free and according to Williamson (47) is provided by a specialized anastomatic arrangement of capillaries within the lobule.

#### PHYSIOLOGICAL FACTORS

The physiology of the gland has been intensely studied but is not well understood. The secretion enter the blood stream either through the lymphatic or blood capillaries both of which form a complicated network through the glandular tissue. According to some authors this internal secretion has a bactericidal property. Watkins (45) believe that the renewed hormone content of the blood after it reaches the thyroid determine the failure of extraneous material carried to the gland to be readily deposited therein or to undergo the characteristic evolution there.

The physiological increase in the size of the gland together with the accompanying anatomical changes that occur at puberty during pregnancy during menstruation and during severe fevers makes the gland more susceptible to infection. In fact many of the cases of acute thyroiditis not due to direct trauma appear after a period of physiological stress. In 67 cases 13 followed delivery, 9 followed pneumonia, 5 followed typhoid fever and 3 occurred in young girls at puberty following acute upper respiratory infections. Females are attacked with acute thyroiditis more often than males and the highest percentage of occurrence is found during the child bearing period (0 to 40 years). Robertson (33) found 52 females in 96 cases and I found 47 females in 67 cases. Jeanselme (20) remarked in 1895 that pregnancy reacts on the thyroid and transforms it into a veritable venous sponge. Following pregnancy the thyroid hypertrophy diminishes but never completely disappears. That anatomical and physiological disturbances following this evolution and resolution occur and render the gland less resistant to infection can be readily understood.

As in the uterus and breast structures undergoing great physiological changes during puberty and pregnancy adenomata form frequently in the thyroid. These adenomata are sites of fibrosis, abnormal cell proliferation, blood vessel distortion and frequent hemorrhage, all producing areas of lowered resistance. Moreover the adenoma produces atrophy of the surrounding acini together with a localized fibrosis, slight inflammatory infiltration and thickening of the blood vessel walls, a chronic non suppurative thyroiditis which Warthin (44) believes is due to mechanical pressure. This inflammation produces an area of lowered resistance to any extraneous material that may reach the gland. In 24 of my 67 cases adenomatous goiter was present before the acute thyroiditis developed. In 31 of Robertson's (33) 96 cases goiter was present first and in most cases was adenomatous.

To summarize one may say that the rich blood supply and the production of the thyroid hormone tend to prevent infection of

the thyroid while the physiological changes occurring during puberty, menstruation, pregnancy and acute infections and the development of adenomata in the gland tend to lower the resistance of the thyroid.

#### PATHOLOGICAL ASPECTS

Thyroiditis may be acute or chronic suppurative or non suppurative and acute reactions can be ascertained clinically in the suppurative lesions. In my own case considerable necrotic tissue was removed at the operation. There were areas showing dilatation of the capillaries, polymorphonuclear infiltration of the interstitial tissue and the acini, hemorrhage into the interstitial tissues and the acini, coagulation of the colloid and all types of cell pathology ranging from cloudy swelling to complete necrosis. Clute and Smith (9) likewise found dilatation of the capillaries with diapedesis or frank hemorrhage, leucocytic infiltration of the alveolar epithelium and even the lumen of the acini. They also found diminution in the amount of colloid with replacement by a granular precipitate.

The acute inflammation may resolve or go on to suppuration and gangrene. Resolution occurs by absorption of the lymph and new cells and by the changing of the angioblastic and fibroblastic tissues into vascularized fibrotic tissues. Watkins (45) found evidence of acute reaction in some of the interstitial types of thyroid removed at operation where active fibroblastic proliferation was occurring. Acute non suppurative lesions are transitory in character, resolution occurring within a week or 10 days. Of 96 cases reported by Robertson (33) 56 were of the non suppurative type, of my 67 cases 4 resolved without suppuration. One of these followed delivery, one followed the grippe (and had occurred for 3 successive winters), one followed trauma to the neck and exposure to the cold and one was primary.

Acute suppurative lesions may consist of multiple milium abscesses or may be large pus pockets involving one or both lobes of the thyroid. Most frequently the right lobe is involved next in frequency the left lobe and Stein (37) reports a case in which the pyramidal lobe alone was abscessed.

Chronic non suppurative thyroiditis of the non specific variety is seen in the neighborhood of adenomata and is associated with pressure atrophy of the acini. There is a localized fibrosis of the interstitial tissue slight round cell infiltration and thickening of the blood vessel walls. Of the specific non suppurative variety tuberculosis and syphilis occur. Tuberculosis of the thyroid is characterized by the development of a hard nodular tumor of rather rapid growth. Pathologically the picture is characterized by tuberculous granulations fibrosis caseation and calcification. Microscopically the picture is typical of tuberculo is an avascular concentrically arranged mass of cells consisting of a central area of caseation with multiple foreign body giant cells surrounded by a ring of epithelioid cells about which is a mononuclear round cell infiltration of the lymphoid type. Secondary infection does occur and in acute thyroiditis with abscess formation may result. Vannoy (42) operated on such a case. The abscess occurred in the inferior region of the neck and after incision healed in 3 months. Seven years later another abscess pointed at the inferior end of the old incision. The surgeon probed the sinus and thought the condition was Pott's disease as there was a sensation of roughness and grating as imparted by diseased bone. He also found a sinus leading posterior to the sternum probing at the bottom of which imparted a similar sensation and led him to believe that there was an osteomyelitis of the posterior surface of the manubrium. Only at operation did he find that he was faced with an acute thyroiditis with abscess formation superimposed on a calcified thyroid.

Syphilis occurs in two forms the diffuse thyroiditis syphilitica and gummatous of the thyroid. Davis (10) reports 17 cases of syphilis. The pathological picture is characteristic of syphilis as it appears in other tissues. In diffuse thyroiditis syphilitica there is perivascular round cell infiltration with fibroblastic and angioblastic proliferation and a progressive endarteritis of the regional blood vessels. In the gumma there is a central hard firm area of coagulation necrosis surrounded by dense tissue rich in epithelioid cells and closely infiltrated with mononuclear wandering

cells. Giant cells may be present and there is usually an associated obliterative endarteritis of the smaller vessels. No acute superimposed thyroiditis with or without abscess formation has been recorded in the literature.

Piedels (3) ligeneous thyroiditis deserves consideration at this point. The etiology of this process is unknown and there is doubt as to its true inflammatory nature. It is characterized by a marked fibrosis of the thyroid with adhesions to the adjacent structures that are so firm that the condition is usually diagnosed as malignant. No report has been made of an acute inflammation superimposed on a ligeneous thyroiditis.

Many pathologists on finding localized collections of lymphocytes with or without germ centers in glands examined for exophthalmic goiter toxic adenoma and toxic hyperplasia have called the picture thyroiditis and assigned this as an explanation for the toxicity. Watkins (45) however believes that the lymphocytic cell collections are not inflammatory but are evidence of a thymic-lymphatic constitution in other words are evidence only of a lymphatism. Clute and Smith (9) on the other hand believe that these cell collections are evidence of a mild inflammatory process. In considering the relationship of the cell collections and Graves disease they observed no evidence of these cell nests in so many toxic goiters that they feel that there is no relationship between this cellular inflammatory reaction and the glandular hypertrophy and associated increased metabolism.

The etiology and clinical significance of these cell nests is a problem one authority maintains that they are part of a general lymphatism while another maintains that they are due to a chronic inflammation. A third consideration might be that these are undifferentiated cells such as occur in the breast and which on proper physiological stimulation spring into activity and form acini.

#### CLINICAL OCCURRENCE

Acute thyroiditis occurs most commonly in the female sex. Robertson (33) reported 52 females and 32 males in 96 cases. I found

in 67 cases 47 females and 20 males. The age occurrence varies from 18 months to 77 years the oldest being my own patient. Table I shows the age occurrence in 65 cases.

TABLE I — AGE OF PATIENTS AT TIME

Age y	N		Age y	N	
	p	t		p	t
1-10			50-60	11	
10-20	7		60-70	4	
20-30	14		70-80	2	
30-40	14			—	
40-50	11		Total	65	

Robertson (33) found in his 96 cases that the age of greatest frequency was the same as that shown in Table I (between 20 and 40 years).

The relationship between goiter and acute thyroiditis is interesting. Some authors believe that acute thyroiditis occurs only in previously diseased glands. Hagenbuch (16) reported 43 cases of which only 5 had goiter. 32 of Robertson's (33) 96 cases had goiter and 32 of my 67 cases suffered from goiter previous to the acute infection. 24 of these 32 were adenomatous in type. 3 showed general hyperplasia and 5 were unclassified. Seven of the cases I studied showed toxic goiter symptoms during the acute infection. One of these reported by Rogers (34) suffered a postinfection thyrotoxicosis. One reported by Greenberg (14) who had suffered a severe thyrotoxicosis previous to the infection recovered from the toxic state after the infection although part of the gland was resected at the operation performed and this might account for the recovery. One individual studied by Weeks (46) developed severe myxedema after a drainage operation from which she recovered only after the wound sinus closed. Of the remaining 63 cases 10 showed no postoperative thyroid disturbances and 53 were unclassified.

The etiological factors in acute thyroiditis are numerous. Trauma to the gland produced a severe attack of thyroiditis in a case reported by Link (26). The patient had a toxic goiter which was treated by a rubber. An acute thyroiditis developed and at operation the gland was found to be a veritable carbuncle. Drainage was instituted but the patient succumbed. Puncture wounds with infection

of the thyroid were observed during the World War. Aside from the direct trauma infection may occur in four ways.

1 By extension through a persistent thyroglossal duct.

2 By direct invasion from contiguous structures. Cleland (8) performed an autopsy on a patient who had purulent perichondritis of the tracheal cartilages with extension of the suppuration to the thyroid.

3 By lymphatic metastases. That infection reaches the thyroid through the lymphatics is a debatable point. So many infections occur after pharyngitis, tonsillitis and other upper respiratory infections with the associated lymphadenitis that it seems probable that organisms do reach the thyroid in this manner. The natural lymphatic current flows from the thyroid gland to the deep cervical lymph glands but with the clogging of these natural channels following severe infection in their regions of drainage the natural drift may be stopped or even reversed and organisms be carried to the gland. In my series of cases 13 followed upper respiratory infections such as pharyngitis or tonsillitis, 1 followed multiple ulceration of the tongue, 1 followed quinsy and 1 followed mastoiditis. Robertson had 3 cases following tonsillitis and 4 cases following diphtheria. Hagenbuch had 6 cases complicating Vincent's angina, 1 complicating tooth extraction and meningitis and 3 cases following acute upper respiratory infections.

4 By blood stream metastases. This is the most common mode of infection. Acute thyroiditis in my series complicated typhoid fever 5 times, pneumonia 9 times, empyema once, influenza 8 times, erysipelas 3 times, puerperal septicemia 13 times and multiple suppurative arthritis once. Robertson had 7 cases following acute rheumatic fever, 6 cases following pneumonia, 6 following acute enteric fever, 4 following erysipelas, 4 following influenza, 4 following puerperal sepsis and 4 following malaria. Hagenbuch reported 8 cases following influenza and 9 following pneumonia. Metastases by the blood stream is the most logical and only adequate explanation for the development of acute thyroiditis as a complication of these maladies.

The bacteria involved in infection of the thyroid are numerous. In 63 cases in which suppuration occurred the organisms isolated were typhoid in 2 cases paratyphoid A in 1 case paratyphoid B in 1 case pneumococcus in 3 cases streptococcus in 10 cases staphylococcus in 7 cases streptococcus and staphylococcus in 1 case and staphylococcus and saprophytes in 1 case.

Robert on obtained cultures from 7 of the 41 suppurating cases and found pneumococcus in 4 cases typhoid in 1 case and streptococcus in 1 case.

Briggs and Scribner (5) found 17 cases of typhoid thyroiditis besides their own case which was due to the typhoid bacillus the organism being isolated in pure culture from the abscess cavity.

In addition Osler and McCrae (30) state that acute thyroiditis may occur in the course of smallpox measles scarlet fever and mumps. Epidemics among children and among soldiers have been reported.

#### CLINICAL SYMPTOMATOLOGY

The onset of acute thyroiditis is usually sudden. The first symptom in 7 of the cases studied was pain in the neck over the thyroid gland. It is lancinating in type and may radiate to the mastoid region or the ear. The pain is aggravated by extension of the head because the muscles and heavy fascia compress the swollen tender gland when the chin is elevated and as a result the patient holds the head in a bowed position.

Swelling or tumor formation over the thyroid was the first symptom observed in 25 of the 67 cases. This swelling may involve one lobe or both lobes or the whole thyroid gland may stand out in relief. The swelling may extend from the chin to the manubrium and the chin may be drawn to the diseased side by the inflammatory distention of the cervical tissue. In cases of adenomata the tumors swell rapidly while the remaining portion of the gland may show no increase whatsoever in size.

Tenderness over the thyroid gland was present in 63 of the 67 cases and in 4 cases this was the first complaint. The tenderness was exquisite in 10 of the cases.

Chills and fever initiated the disease in 20 of the cases. Fifty seven of the patients had fever which ranged from 99 to 104 degrees. The temperature tends toward the saw tooth type especially when an abscess forms in the gland.

Coughing occurred in 10 of the cases. It is spasmodic in type and is usually a harsh dry non productive hacking. Occasionally mucus and blood stained sputum is raised. Brenzner (4) reports the case of a man who had an abscess which evacuated into the larynx so that a great quantity of pus and sloughing tissue was expectorated. Gemenez and Zupola (15) had a similar patient whose abscess ruptured spontaneously into the trachea and who coughed up a great quantity of pus. Ribattu and Gillard (31) and Theisen (38) reported case with spontaneous evacuation into the larynx accompanied by a cough and expectoration of purulent fluid.

Hoarseness was mentioned in 1 of the cases. This is due to oedema swelling and venous congestion of the laryngeal mucous membrane. Complete aphonia developed in 4 cases. According to Theisen (38) this is not due to a cord paralysis from pressure on the recurrent nerve but to venous congestion and oedema the latter occurring in the supra glottic or infraglottic region and not in the cords themselves.

Dyspnoea developed in 32 of the cases sometime in the course of the disease and in one case was the first symptom. It is due to swelling and oedema of the tracheal epithelium and to compression and displacement of the air passage by the abscess. Choking occurred in 7 of the cases. 2 were relieved by tracheotomy incision and drainage of the abscess. 3 were treated by the latter procedure while 2 ruptured spontaneously before surgical intervention was practiced.

Dysphagia was reported in 19 cases in 2 of which it was the first symptom. It is due to pressure on the oesophagus by the swollen gland and to oedema and inflammation of the oesophagus mucous membrane.

Partial ptosis with corneal anesthesia due to sympathetic nerve pressure and vomiting with a slow pulse from vagus nerve pressure are mentioned as symptoms by Stein (37). I

found neither of these recorded in the case reports that I studied

Fluctuation in event of abscess formation may or may not be present In 26 of the cases fluctuation was obtained The deep seated position of the gland and the heavy planes of fascia which surround and protect it make palpation for the presence of abscess formation difficult The tumor often imparts a characteristic tense hard sensation to the examining finger yet there is a sensation of fluid under pressure and anterior bowing of the head to relax the overlying muscles and fascia will allow the examiner to obtain fluctuation In 34 of the 67 cases the surgeon discovered no fluctuation although free pus was found at operation In these cases there was a brawny indurated consistency due to  $\alpha$ dema and congestion of the overlying and contiguous structures

Redness of the overlying skin occurred in 30 of the 67 cases The redness was most marked in the fluctuating adenomata 3 of which ruptured spontaneously either before the patient entered the hospital or before surgical intervention could be instituted The first 4 constitute a diagnostic quadrad Abscess formation may be determined by the pressure of fluctuation in the swollen tissue and by the temperature and leucocytosis and the general picture of toxæmia which occurs when pus is present under tension in the body tissue

Toxic goiter symptoms evidenced by tachycardia nervousness tremor of hands sweating and exophthalmos developed in 7 of the cases In 3 of these a toxic goiter was present before the onset of the acute thyroiditis

The following symptoms and signs are therefore characteristic of acute thyroiditis

- 1 Pain over the thyroid gland
- 2 Swelling of the thyroid gland or of an adenoma of the thyroid
- 3 Tenderness over the thyroid
- 4 Chills and fever
- 5 Coughing
- 6 Hoarseness and aphonia
- 7 Dyspnœa
- 8 Dysphagia
- 9 Thyrotoxicosis

In case abscess formation occurs two other signs develop

- 10 Fluctuation in the tumor mass
- 11 Redness of the overlying skin

#### DIFFERENTIAL DIAGNOSIS

Physiological hypertrophy of the thyroid at adolescence during pregnancy or during menstruation is differentiated from acute thyroiditis by the absence of pain absence of fever and the absence of marked tenderness

Hæmorrhage into the thyroid gland or into an adenoma is characterized by a sudden rapid swelling and by sharp pain at the onset followed by a gradual subsidence of the pain In thyroiditis however the swelling develops less rapidly and the pain which is mild at first increases in severity

Malignancy of the thyroid has a characteristic nodular hardness and the regional lymph nodes are involved early The sudden onset the rapid growth the temperature and leucocytosis which are characteristic of acute thyroiditis are not found in malignant cases Tenderness may be ascertained by palpation over a malignant gland late in the disease after the regional lymph glands have been involved and the capsule of the thyroid has been broken through by the malignant growth

Glossitis and abscess formation at the base of the tongue with the associated cervical œdema and swelling may resemble acute thyroiditis The latter disease is unaccompanied by any pathological changes in the floor of the mouth so that it can be ruled out by an oral examination

Bronchial and thyroglossal cysts develop suddenly when hæmorrhage or infection of their contents occur They are situated cephalad to the thyroid gland and are often present and recognized before the acute attack develops No toxic goiter symptoms result from an infection in a bronchial or thyroglossal cyst If the pyramidal lobe of the thyroid is involved alone as already mentioned differentiation from an infection in a thyroglossal sac may be possible only at operation

Perichondritis of the laryngeal cartilages will produce pain tenderness hoarseness

coughing and dyspnoea. The laryngeal symptoms are more marked than in acute thyroiditis; there is an absence of any tumor formation and the laryngoscopic examination may lead to the demonstration of the true pathology of the condition.

Cellulitis and phlegmon of the neck may be difficult to differentiate from the acute thyroiditis in which the cervical structures from the mandible to the sternum are involved. In cellulitis the swelling usually commences in the region of the mouth and spreads downward while thyroiditis begins in the gland. The swelling in cellulitis is more diffuse and follows the fascial planes. The pain is usually not marked in cellulitis at the onset and starts at the site of the original infection while the pain of acute thyroiditis is lancinating at the onset and begins in the gland. Thyrotoxic symptoms are absent in a cervical cellulitis unless there is an associated toxic goiter in which event the toxicity will certainly be aggravated. A diagnosis may be impossible without operation.

#### PROGNOSIS

The prognosis in acute thyroiditis is excellent if the disease is recognized and treated properly. Resolution occurs in 10 to 14 days in the non suppurative type. In the suppurative type the prognosis for recovery is good but the convalescence may be long and stormy. Complications such as perforation into the larynx or trachea, mediastinitis, pyæmia with secondary infection of the bursa joints and bone as occurred in my case postoperative myxoedema and thyrotoxicosis may well exhaust the patient. Recurrences have been reported. Vinnik (4) treated a suppurative case by drainage but the infection recurred 7 years later and incision and drainage were again necessary before complete recovery was obtained. Sherrin (36) treated a man with acute thyroiditis of the non suppurative type who had had similar attacks for 4 successive winters. Death occurred in 1 of Hagenbuch's (16) 47 cases. In the non suppurating cases 2 of 55 patients died and in the suppurating type 9 of the 41 died making a total of 11 deaths in the 96 cases reported by Robertson (33). In my series of 67 cases 11 patients died

and 56 recovered making a death total of 24 in 100 or a mortality rate of 24 per cent.

#### TREATMENT

The general treatment in acute thyroiditis is directed toward relief of the general malaise, chills and fever, headache, sleeplessness and pain. Ice cups to the head, coat tar, antipyretics, codeine or morphine if the pain is very severe, saline cathartics in doses sufficient to produce a good daily bowel movement and tepid sponges in event that the temperature rises over 100 degrees are helpful. A liquid diet is necessary in some cases because of the dysphagia and in such an event nourishment should be given every 4 hours during the day. Nutritious drinks such as cocoa, egg nogs, well sweetened orange juice and milk are preferable. If the patient does not suffer from dysphagia a regular house diet supplemented with mid morning and afternoon feedings is best. In specific inflammations specific curative measures are indicated. Typhoid vaccine, pneumococcus serum and meningococcus serum have been used in thyroiditis complicating typhoid pneumonia and meningitis.

The local treatment in acute non suppurative thyroiditis consists in the application of cold or heat. Ice packs during the stage of enlargement and oedema that is during the first 4 to 48 hours are used in an effort to limit congestion. Dry heat is then applied to hasten resolution. If ice packing allays the pain better than heat it should be used as long as it is efficacious.

If suppuration ensues in spite of treatment as it did in 30 of Hagenbuch's 43 cases in 40 of Robertson's 96 cases in 63 of my 67 cases prompt incision and drainage is the best treatment. Delayed resolution with persistence of the symptoms of toxæmia beyond the 10 to 14 day period, an irregular fever, increase in the pain, steady increase in the size of the tumor with the associated pressure symptoms indicate abscess formation. Fluctuation may be a certain but this is not essential for a diagnosis because the heavy fasciæ swelling and oedema of the contiguous parts can mask suppuration in the thyroid gland very easily. Large monolocular or multilocular abscesses require incision and

drainage Various incisions have been made such as vertical incisions in the midline incisions along the anterior border of the sternocleidomastoid muscle in the presence of unilateral swellings and incisions made transversely over the most dependent area of the swelling but the best approach is secured by a collar incision through the skin and platysma muscle The intermuscular fascia is then split longitudinally and the sternohyoid and sternothyroid muscles are retracted laterally on either side until exposure of the inflamed gland is obtained Lahey (4) believes that the ribbon muscles should be severed on either side through part of their width at least so that the longitudinal incision in the intermuscular fascia will gape and promote free drainage After the abscess has been exposed it is opened widely if rupture has not already occurred during the operation The cavity is then sponged out gently Although many surgeons favor curetting the walls this method is contraindicated because blood vessels may be opened and dangerous hemorrhage result Mosetig (20) reports such a case of fatal postoperative hemorrhage Drainage is best insured by a good sized hard rubber tube The tube may have multiple perforations cut along its sides and may be split part of its length the two split pieces being separated when the tube is placed one piece going to each pole of the infected lobe so that free drainage is insured from the most remote areas after collapse of the abscess wall occurs In case both lobes of the thyroid have suppurated two such tubes should be used

In the cases of multiple military abscess formation in the gland subtotal thyroidectomy has been practiced This is a dangerous type of infection Schuyler (35) reports two fatal cases Link's (26) patient died but Greenberg's (14) recovered giving a mortality of 75 per cent in the cases that I studied

In the presence of suppuration in a single adenoma Vianny (42) practiced strumectomy of the abscessed adenoma in 4 cases drained and performed a secondary strumectomy in 2 cases and executed a simple incision in one case Clute and Smith (9) believe that the abscessed adenoma should be removed if the local and general condition of the patient will

permit The more conservative procedure of incision and drainage with secondary strumectomy after the acute attack subsides appeals to me as based on sound surgical principles

#### SUMMARY

1 Acute thyroiditis occurs often enough so that the members of the medical profession should be cognizant of its existence as a clinical entity

2 Acute thyroiditis is characterized by a quadrad of symptoms (1) pain over the thyroid (2) swelling or tumor formation over the thyroid (3) tenderness over the gland and (4) fever

3 Conservative measures are indicated in the non suppurative variety Surgery is always indicated in event of suppuration

#### BIBLIOGRAPHY

- 1 ARMSTRONG J Am M Ass 1911 1 1 280
- 2 BAHRI Rev hebdomadaire de laryngologie Par 1911 1 129-133
- 3 BELLEY Albany M Ann 1910 1 173 1 0
- 4 BRENNER Ann Surg 1927 lxxxv 330-346
- 5 BRIGGS and SCRIBNER Virginia M J 1914 249
- 6 BULLOWA Med Clin N Amer 1921 v 1125-11 8
- 7 CARNOT BLANCHET Bull et m Soc m d d 1866 de Par 1923 1 66-68
- 8 CLELAND Med J Australia 1927 1 790-791
- 9 CLUTE and SMITH Surg Gynec & Obst 1927 1 23
- 10 DAVIS Tr Chicago Path Soc 1907-09 11 273
- 11 EDWARDS J Am M Ass 1921 lxxv 637-639
- 12 FUNK Proc Med 1921 11 3
- 13 GEMFNEZ ZAPOLA and SANCHEZ Semana med 11 566-569
- 14 GREENBERG J Am M Ass 1920 lxxv 65
- 15 GRIMAUD and BRINO Cynec et obst 19 11 167 17
- 16 HAGEBUCH Mitt a d Grenzgeb d Med u Chir 1921 v 11 181
- 17 HALBERT Ann Clin Med 1 61
- 18 HOOPS Grace Hosp Bull Detroit 1917 13
- 19 JABOULAN and FAUOL Lyon med 191 1 1316-1318
- 20 JFANSELMINE Gaz d hôp 1805 11
- 21 KUMMER Rev med de la Suisse Rom 1920 1 36
- 22 KYLE Med Times N Y 1917 1 251
- 23 LABEY Bull et mém Soc de chir le Par 1918 1 697
- 24 LAHEY Boston M & S J 1917 clxxvi 04
- 25 LEMIERRE and TABERLET Bull et mém Soc m d d 1866 de Par 1919 35 1 11 513
- 26 LINK Personal communication
- 27 MAYO CHARLES H Surg Gynec & Obst 1921 lxxv 209-213
- 28 MEKKER Am J Path 1915 1 57
- 29 MOSETIG and MORRIS Wien med Pres e 1879
- 30 OSLER and McCRAE The Principles and Practice of Medicine
- 31 RABATTU and GILLARD Lyon méd 1921 729-734
- 32 RIEDEL Verhandl d deutsch Gesell ch f Chir 1896 lxxv 101



- 33 ROBERTS V Lanc t 1911 1 93  
 34 P GERS La t 927 868 869  
 35 SCHIVER J M d 19 7 v 253 55  
 36 SHER IS C y Ho p Gaz Lo do 916 xxx 35  
 37 Sr IN Laryng cope 91 xvi 5  
 38 THEISEN T Am Laryngol As xx 24  
 39 TOURNEUX F g è m éd P o xxv 371  
 4 VALLOIS nd RONNE Bull Soc d ob t et d g  
 de P 92 1 66  
 42 VIANNY Lyon ch ru g 1923 x 8 0-8 7  
 43 VIOLA Rifo ma med 924 xl 465 466  
 44 WARTHIN An Cl n M d 9 4 4  
 45 WATKINS An Cl M d 924 iv 6 8 64  
 46 WEEKS Brit M J o o 476  
 47 WILLIAMSON B t J Surg 19 6

## THE BACTERICIDAL ACTIVITY OF HEXYLRESORCINOL (SOLUTION S T 37) ON WOUND SURFACES

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 F m th D partm f B er l gy School f Hyg en d P bl H l h J h H pk U y

THE bactericidal activity of hexylresorcinol in glycerine has been previously described (2). Certain experiments by the writers which have led to the selection of hexylresorcinol in 30 per cent aqueous glycerine (solution S T 37) as the solution best suited for the purposes of general antiseptics have been reported in a previous communication (3).

The purpose of the present article is to describe a simple technique by which the suitability of any given germicide for use as a prophylactic against infection in accidental or operative wounds may be readily determined and to describe the results obtained in the rapid disinfection of experimentally infected wounds with solution S T 37.

In the first place most germicides suffer a marked loss in bactericidal activity in the presence of organic matter which is of course present in every wound and on all mucous surfaces. In the case of certain types of germicides this loss of bactericidal power may be practically complete in the presence of 3 per cent of organic matter (1 per cent of peptone and 1 per cent of gelatin) which is the standard adopted by the U S Hygienic Laboratory (1). Such germicides are obviously unsuitable as prophylactic agents. It would appear to be logical therefore to test a given germicide in the presence of the standard concentration of organic matter before proceeding to any actual experiments on wounds and to determine this activity not only in the standard peptone gelatin mixture

but also in the same concentration of normal serum and of whole blood as well for the reason that this is the particular type of organic matter met with under practical conditions in wound disinfection.

The bactericidal activity of solution S T 37 in the presence of 3 per cent peptone gelatin blood serum and whole blood is shown in Table 1. These experiments were conducted at 37 degrees C. 5 cubic centimeter amounts of solution S T 37 containing the requisite quantity of organic matter being inoculated with one standard 3 millimeter loopful of a 24 hour filtered broth culture of the test organism the same inoculum being transferred to 10 cubic centimeters of fresh beef infusion broth at each of the time intervals indicated and the tube then incubated for 48 hours.

The test organisms and the time intervals chosen for these experiments are the same as those employed in the tests on wound disinfection described below. As shown in the table solution S T 37 was found to be completely effective in 1 minute against each of the four test organisms in the presence of the standard concentration of peptone gelatin solution normal horse serum and citrated rabbit's blood.

### RAPID DISINFECTION OF EXPERIMENTALLY INFECTED WOUNDS WITH HEXYLRESORCINOL (SOLUTION S T 37)

In the technique to be described an attempt has been made to standardize controllable

TABLE I — THE BACTERICIDAL ACTIVITY OF SOLUTION ST 37 IN THE PRESENCE OF THREE PER CENT ORGANIC MATTER (U. S. HYGIENIC LABORATORY STANDARD)

Organism	Inoculum	Time of exposure			Result
		1 m	5 m	30 m	
In 1% gelatin	Staphylococcus aureus	0	0	0	+
	Streptococcus viridans	0	0	0	+
	Streptococcus hemolyticus	0	0	0	+
	Bacillus coli	0	0	0	+
Normal horse serum	Staphylococcus aureus	0	0	0	+
	Streptococcus viridans	0	0	0	+
	Streptococcus hemolyticus	0	0	0	+
	Bacillus coli	0	0	0	+
Citrated rabbit blood	Staphylococcus aureus	0	0	0	+
	Streptococcus viridans	0	0	0	+
	Streptococcus hemolyticus	0	0	0	+
	Bacillus coli	0	0	0	+

ical means. *Streptococcus viridans* and *Streptococcus hemolyticus* were included because of the frequency and the seriousness of wound infection by these organisms. *Bacillus coli* was chosen to represent the Gram negative organisms because of its resistance to chemical disinfection and because it is not infrequently responsible for wound infection.

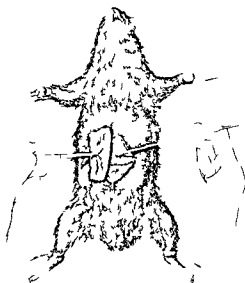
**Media and preparation of cultures.** *Staphylococcus aureus* and *Bacillus coli* were transferred daily in standard peptone (Armour's) broth of pH 6.6-6.8 while the two *Streptococcus* cultures were transferred daily in fresh beef infusion broth (pH 6.6-6.8) until luxuriant growth appeared on 24 hours incubation. Thereafter all cultures were transferred daily in the respective media and fresh 24 hour cultures invariably used in the tests.

**Preparation of bacterial suspensions for wound inoculation.** The day before the wound experiments were to be made the number of organisms in the 24 hour broth culture to be used was determined by plating out in fresh beef infusion agar 1 cubic centimeter of each of a series of dilutions in physiological saline solution. After 24 hours incubation of the plates at 37 degrees C the colonies were counted and the broth culture which had meantime been stored in the ice box at 5 degrees C was then diluted with the calculated quantity of physiological saline solution to give a suspension containing 200,000 organisms per cubic centimeter. The counts were checked once or twice for each culture after 24 hours storage in the ice box and were never found to vary to any considerable degree. A suspension containing 100,000 organisms per cubic centimeter was chosen for the reason that 0.5 cubic centimeter of fluid was found to cover completely the entire wound surface employed. This inoculum contained therefore 100,000 organisms evenly distributed over the wound surface—a figure which was selected arbitrarily but which it was felt represented an inoculum well above the average accidental infection.

**Preparation of the animal.** Guinea pigs were used exclusively in these experiments. The pig being held by an assistant the hair was first removed from the abdomen with ordinary clippers and the entire abdomen

conditions with a view to developing a simple but dependable method by which the suitability of a given germicide for use as a prophylactic agent in fresh wounds might be readily determined in any laboratory. Such considerations as trauma as by crushing and the presence of foreign material in the wound are not considered in this technique for the reason that they cannot be readily standardized. The method merely represents a test under standard conditions by which the efficiency of a given germicide to disinfect a wound surface within a given time may be determined.

**Selection of test organisms.** *Staphylococcus aureus* was selected as a test organism not only because it is commonly responsible for wound infection but also because it is generally considered to be the most resistant of the pyogenic cocci to disinfection by chem-



1 k      Sh   n   th      3 tl   ppl   t      f tl  
h m d l   m h f k      po g   d th m th l t  
t k      3 lt      t l f      t t      t l

shaved. Ether was then administered and the plicatures tied down on an ordinary wire test tube rack as for a laparotomy. The skin of the abdomen was thoroughly wiped off with a sterile gauze or cotton sponge saturated with solution S 1 7 and a fresh sterile gauze sponge saturated with the solution placed over the operative field where it was allowed to remain about a minute.

A triangular skin flap with the upper angle in the mid line about 2 to 3 centimeters below the xiphoid process was next laid back to expose a triangular area of the anterior abdominal fascia measuring about one inch along each side.

**Wound inoculation.** One half cubic centimeter of the suspension of the test organism containing about 100,000 viable organisms was allowed to flow into the wound from a sterile graduated pipette, even distribution of the material over the wound surface being facilitated with the point of the pipette when necessary.

**First control.** A sterile swab consisting of the ordinary wooden applicator stick with an absorbent cotton end and sterilized in an individual test tube was then stroked over the wound surface and the material transferred to the surface of a plain agar or blood agar plate depending on the organism used.

This constituted the first control to prove the viability of the organism on the media used and also that the inoculation had in fact been made as intended.

**Second control.** A gauze sponge saturated with solution S 1 3<sub>1</sub> was then placed over the wound covering the entire wound surface. Thirty seconds later the sponge was lifted and the wound surface stroked with a sterile cotton swab which is then dipped in the saline suspension of the organism and the material transferred to the surface of an agar plate. This constituted the second control and covered a point seldom controlled in experiments of this kind—namely the possibility of transferring sufficient germicide on the culture swab to prevent the growth of any viable organism which may have been transferred with it. The appearance of growth in the second control plate ruled out the possibility of such an occurrence in the wound culture taken subsequently.

**Wound cultures.** At the expiration of exactly one, two and five minutes after application of the germicide the gauze sponge was lifted, a sterile swab stroked over the wound surface and then transferred to the surface of an agar plate. This is illustrated in Figure 1.

In the transference of the material removed by the swab to the surface of the agar plate the same procedure is invariably followed. The swab is stroked rapidly back and forth along one diameter, the swab meantime being rotated in the fingers of the right hand with a twisting motion and the plate gradually being rotated with the left hand until one complete revolution had been made. This brings every portion of the surface of the swab into direct contact with the agar and distributes the material evenly over the surface of the plate.

All plates were incubated for 48 hours at 37 degrees C. before the results were recorded.

This experiment was repeated three times with each of the four test organisms. As shown in Table II the first and second controls showed satisfactory growth in every case while in no case did solution S 1 3<sub>1</sub> fail to effect complete disinfection of the wound surface within 1 minute. The appearance of

TABLE II — DISINFECTION OF FRESHLY INOCULATED WOUND SURFACES WITH HEXYLRESORCINOL (SOLUTION S T 37)

T	T	g	m	C		W		J	h
				g	l	g	l		
1	Staphylococcus aureus	+	+	0	0	0	0	0	0
2	Staphylococcus aureus	+	+	0	0	0	0	0	0
3	Staphylococcus aureus	+	+	0	0	0	0	0	0
4	Streptococcus viridans	+	+	0	0	0	0	0	0
5	Streptococcus viridans	+	+	0	0	0	0	0	0
6	Streptococcus viridans	+	+	0	0	0	0	0	0
7	Streptococcus hemolyticus	+	+	0	0	0	0	0	0
8	Streptococcus hemolyticus	+	+	0	0	0	0	0	0
9	Streptococcus hemolyticus	+	+	0	0	0	0	0	0
10	Bacillus coli	+	+	0	0	0	0	0	0
11	Bacillus coli	+	+	0	0	0	0	0	0
12	Bacillus coli	+	+	0	0	0	0	0	0

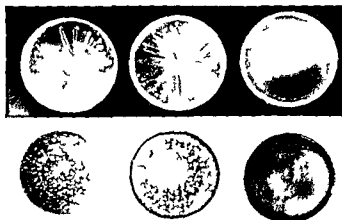


Fig. 1. Appearance of control plates and wound culture plates. Top row staphylococcus aureus bottom row streptococcus hemolyticus.

In each row the plate at the left (first control) shows the result of the wound culture taken before application of the germicide. The growth shown on the middle plate (second control) prove that insufficient germicide was transferred on the culture as to prevent growth of the organisms. The sterile plates at the right in each row show the result of the wound cultures taken 1 minute after application of the germicide.

preliminary to bactericidal activity. Fortunately then the problem of prophylaxis in accidental wounds which may contain spores in the infectious material present resolves itself as far as the spores are concerned into that of preventing their germination. The complete prevention of germination (sporostasis) by minute quantities of antiseptics or germicides bears no relation whatever to the resistance of the spore to disinfection. For example the stock strain of bacillus subtilis carried in this laboratory produces spores which survive boiling for 30 minutes and exposure to a saturated aqueous solution of phenol for 30 minutes yet the presence of hexylresorcinol in 30 minute a concentration as 1:60,000 completely prevents the germination of these spores under conditions which otherwise result in prompt and luxuriant growth.

In general it may be considered that the problem of efficient wound prophylaxis is that of promptly killing off vegetative contaminants and of leaving enough of the prophylactic agent in the wound to prevent the germination of spores. A point which one finds but seldom discussed in the large literature on this subject is the fact that moisture may be under ordinary circumstances absolutely essential to disinfection by chemical

the control plates and one minute plates is shown in Figure 1.

The standardized technique described takes no account of wound infection by spores. The actual destruction of ordinarily resistant spores on tissue surfaces without tissue destruction is almost inconceivable to one familiar with the extraordinary resistance shown by these bodies to disinfection by chemical means in spite of reports to the contrary occasionally appearing in clinical literature. In the experiments upon which these reports are based the fact is almost invariably overlooked that the presence of extremely minute quantities of almost any germicide or antiseptic transferred to the culture medium with viable spores will completely prevent their germination.

Spores in themselves can do no harm since germination of the spore is an essential

means. To be really effective the germicide should be present *in solution*. Germicide which evaporate rapidly such as tincture of iodine may be very logically suspected of exerting only a very transient bactericidal action on tissue surface. Whether or not bactericidal activity continue after evaporation through the deposit of the solid constituents of the solution in the tissue moisture and in stained tissue is a highly controversial point and little evidence of experimental nature can be offered for one or the other view. Consideration of this point however lead one inevitably to the conclusion that in the absence of satisfactory proof the safest method of applying a prophylactic

agent would appear to be by means of wet dressings or at least by means of a solution which evaporates slowly.

The simple method described in detail above is presented as one which may be employed in any bacteriological laboratory to determine under standard conditions the suitability of any preparation as a prophylactic agent for wounds.

#### REFERENCES

1. R. and McCLELLAN U. S. Hygienic Laboratory Bulletin 1921
2. V. DER L. O. WARD and WILLIAMS V. F. I. ER. P. II  
J. H. H. P. K. H. P. 0 7 1
3. V. F. I. ER L. F. WARD and WILLIAMS V. F. I. ER. Surg  
Case & Obs. 9 7 1 603

# THE SURGICAL TREATMENT OF GASTRIC AND DUODENAL ULCER

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NO problem in the borderline between medicine and surgery has caused more discussion and divergent opinion than has the subject of gastric and duodenal ulcer. In spite of extensive pathological studies of both clinical and experimental material the pathogenesis of gastroduodenal ulceration remains a matter of conjecture and debate. The indications for and the results of medical and surgical therapy are similarly topics extensively discussed. Furthermore the surgical profession is by no means united in its opinions with regard to the operative methods to be employed. In the absence of concrete proof of the etiology of ulcer it is apparent that the value of surgical procedures in their ultimate analysis must rest upon the permanent results achieved and not upon a theoretical consideration of possible causative factors.

Notwithstanding the deficiencies in our knowledge of gastroduodenal ulcer it must be granted that much progress has been made in the past 20 years. One of the most important contributions to these advances has been the roentgenographic study of the stomach and duodenum which has not only been of the greatest assistance in the precise diagnosis of gastroduodenal ulcer but it has added immeasurably to our concept of the physiology of the stomach and the effect of surgical procedures. Operative methods of all types have been employed in great number and their failure as well as their success has been enlightening. In recent years the introduction of subtotal gastric resection has afforded an unusual opportunity for studying fresh pathological specimens. One cannot but feel that the problem of ulcer is a many-faceted one and should call for concerted study by the pathologist, roentgenologist, internist and surgeon. It is obvious that only through such co-operation can progress be made.

During the past year the writer has had the privilege of serving as a voluntary assistant to Professor von Haberer at the University Clinic at Graz. The primary purpose of this article

is to report on a series of ulcer cases operated upon by Haberer from January 1, 1925 to January 1, 1927. This series was selected because it represented the first group of cases operated upon by Haberer after his arrival in Graz as the successor to von Hacker. This group has the obvious disadvantage of permitting only a short follow-up period but on the other hand it epitomizes the experiences which von Haberer has gained through having performed previously over 1500 gastric resections.

## HISTORICAL

Although scattered references to gastric ulcer can be found in the medical literature as far back as the year 1600 Cruveilhier (10) in 1828 was the first to describe systematically the clinical symptoms and pathological findings. These were confirmed by Rokitsky (34) in 1839. Duodenal ulcer was described by Travers (37) in 1817, Broussais (7) in 1823 and Abercrombie (1) in 1830. The significance of duodenal ulcer was overlooked however until the decade 1900 to 1910 when its importance and frequency were emphasized by the writings of Moynihan (24) and W. J. Mayo (22). With the advent of improved roentgenographic methods of gastrointestinal diagnosis the differentiation of gastric and duodenal ulcers was greatly simplified.

Present day gastric surgery began with the experimental researches of Gussenbauer and von Winawarter (13) which were undertaken in Vienna in 1875. They successfully performed gastric resections on dogs at the suggestion of Billroth who was considering the feasibility of a similar procedure in the radical treatment of pyloric carcinoma. It is interesting to note in passing the seemingly prophetic words of Gussenbauer who stated in 1876 that gastric resection might be as useful in the therapy of gastric ulcer as in the treatment of gastric carcinoma.

The success of the experimental studies of Gussenbauer and von Winawarter led Plan

(30) in 1879 to attempt the first gastric resection on a patient suffering from gastric carcinoma. The stomach and duodenum were united end to end after partial closure of the upper half of the cut end of the stomach. The patient died of peritonitis on the fifth day after operation. Ivydyger (31) in 1880 made a similar attempt in a case of gastric carcinoma but was likewise unsuccessful. The first successful gastric resection in record was performed by Billroth (32) in 1881 in a woman with an extensive pyloric carcinoma. The stomach and duodenum were united end to end and the method of gastric resection is now generally known as the Billroth I although in France it is often referred to as the Jeau operation.

Woeßler (33) in 1881 at the suggestion of his friend Nikolski performed an anterior gastroenterostomy in a case of inoperable gastric carcinoma with pyloric obstruction. Little did he think that this procedure would be the foundation for the most common gastric operation. The occurrence of obstruction of the transverse colon after Woeßler's technique led Courcier (34) to attempt bringing the loop of jejunum through a slit in the transverse colon and anastomosing it to the anterior wall of the stomach. In 1885 von Hacker (35) carried out the first posterior gastroenterostomy and with minor modification this is essentially the operation performed today.

Death following the Billroth I method of gastric resection led to the belief that this method entailed undue tension on the suture.

Tablating the end to end gastroduodenal anastomosis and it was therefore suggested that the stomach and duodenum be closed blindly in the continuity of the gastrointestinal tract reestablished by a gastrojejunostomy. This operation has been the subject of many modifications the most important of which were suggested by Kroenlein (21), Mikulicz (36), Hotzmeister (17), Foley (37), Reichel (38), Moynihan (39) and Balfour (40). Since the underlying principle remains unchanged the operation should be termed the Billroth II.

Doven (41) in 1893 proposed that gastroenterostomy should not be restricted as it had been hitherto to cases of pyloric ulcer but

that it should be employed in all cases of duodenal ulcer associated with severe pain and hyperacidity. He argued that these symptoms were due to spasm of the pylorus and that gastroenterostomy was therefore the logical procedure. The following years comprised the golden era for gastroenterostomy. The operation grew rapidly in popularity and for some time was even employed in cases which presented only gastric symptoms but no positive operative findings. In this latter group the functional results were disastrous and necessitated a secondary operation for the development of the gastroenterostomy stoma.

It was not long before surgeons began to be confronted with unfavorable results after gastroenterostomy for ulcer. Persistence of symptoms often in exaggerated form was not uncommon particularly in cases of gastric ulcer. Furthermore, cancers were reported at hemorrhagic perforation and malignant degeneration of gastric ulcer and compelled surgeons to resort to other methods than simple gastroenterostomy. Kiedel (33) and Lar (42) performed sleeve resections of the stomach leaving the pylorus intact. Eisberg (43) proposed occlusion of the pylorus by dividing the antrum pylori and then performing a posterior gastroenterostomy but this led to a relatively high percentage of jejunal ulcers. Finally since 1915 extensive gastric resections have been employed in cases of both gastric and duodenal ulcer. Billroth I has been recommended chiefly by Haberer whereas other surgeons have favored various modifications of the Billroth II.

#### ETIOGENESIS

Numerous theories have been advanced to explain the development of ulcer but all of them have as their starting point certain accepted clinical and pathological data which they seek to explain by an inductive method. Although the theories lack clinical and scientific proof their consideration is none the less valuable in relation to the empirical facts of ulcer surgery.

Before passing on to a discussion of ulcer theories it is desirable to review briefly a few important facts with regard to the anatomy and physiology of the stomach. The stomach

has been arbitrarily divided in many ways by different authors but in this report the well known Holznecht classification into pars pylorica pars media and pars cardiaca will be employed. The pars pylorica is the motor portion of the stomach hence the term *pars egestoria*. The pars media and cardiaca constitute the digestive part of the stomach thus giving rise to the term *pars digestoria*. Histologically the mucous membrane of the pars pylorica is characterized by its mucous glands whereas the acid and peptic cells are found in the pars media and cardiaca. The pyloric glands extend further upward on the lesser curvature than they do on the greater curvature. That portion of the lesser curvature which extends from the pars cardiaca to the pars pylorica constitutes the *magenstrasse* of Wilder. Here the mucous membrane is stretched tightly over the underlying structures in contrast to the loose folds of mucosa which are found along the greater curvature and in the pars cardiaca. The blood supply of the stomach is mainly furnished by four great arteries although the pars cardiaca receives several branches through the *vasa brevia*. There is no doubt that the blood supply of the lesser curvature is less than that of the greater curvature and that the least vascular area of the lesser curvature corresponds to the pars media where the terminal branches of the pyloric artery and gastric artery anastomose. The arterioles supplying the gastric mucosa are end arteries and their occlusion therefore results in a conical infarction of the mucous membrane.

Two phases of gastric secretion are commonly recognized the primary or psychic and the secondary or chemical. The first is dependent upon stimuli arising from the thought and the sight of food mastication and deglutition. The second phase is chemical and depends upon the contact of food with the pyloric mucous membrane. It is assumed that the control of acid secretion by the pyloric glands is a nervous mechanism although this assumption lacks physiological proof. At all events resection of the lesser curvature and distal two thirds of the stomach as performed in the radical treatment of ulcer results in either a complete absence or great diminution of the free hydrochloric acid content of the

gastric juice. This change occurs even though many acid cells remain in the proximal part of the stomach.

As Cruveilhier pointed out the defects occurring in the normal continuity of the stomach may be divided into two forms the erosion which is a superficial mucosal defect and the ulcer which extends into the deeper layers. Aschoff has emphasized the necessity of separating these two types in considering the pathogenesis of ulcer and most writers are in accord with this view. Aschoff (2) has conveniently classified the erosions of the stomach into two groups. The first form occurs chiefly along the greater curvature in the pars media and pars cardiaca. The erosions are extremely small and numerous they are barely visible to the naked eye and are characterized by a tendency to heal. Gastric erosions of the second type are considerably larger and occur in smaller number along the *magenstrasse*. As contrasted with the former group they are deeper and heal more slowly.

It is beyond the limits of this article to describe fully the many explanations which have been advanced for the pathogenesis of gastric erosions. The earliest theory was suggested by Virchow (38) who thought that they were due to organic changes in the blood vessels. Von Bergmann (4) has maintained that due to disturbances in the vegetative nervous system the blood vessels of the gastric mucosa undergo spasmodic contraction leading to areas of anemic infarction. Other investigators have called attention to the presence of intestinal epithelium in the gastric mucosa and suggest that these islands of aberrant intestinal epithelium have a lowered resistance to the digestive action of gastric ferments. Konjetzny and Puhl (5) believe that the occurrence of gastric erosions is dependent upon inflammatory changes in the gastric mucosa and that the erosions are the product of a diffuse gastritis. Finally there is a small group of workers who feel that the erosions are the result of pure mechanical trauma. Irrespective of how divergent these theories are it must be stated that they have one common factor namely that the actual destruction of the gastric mucosa is the result of digestion by gastric ferments.





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The pathogenesis of gastroduodenal ulcer is obviously of greater clinical importance than the origin of gastric erosions. As regard the relation of erosion to ulcer it cannot be denied that the primary stage of ulcer is necessarily a superficial defect in the mucous membrane. In fact Konjetzny and Puhl have argued that erosions are simply a stage in the development of ulcer. As pointed out by Orator and Metzler (8) this conception is refuted by the fact that in their researches only 26 per cent of the gastric ulcers and 18 per cent of the duodenal ulcers were accompanied by gastric erosions. Furthermore they found erosions in cases of primary gastrocanceroma as well as in cases of gastroptosis and antrum gastritis. Aschoff (9) has maintained that the frequency of ulcers in the region of the lesser curvature is due to the fact that erosions of the magenstrasse are continually exposed to both chemical and mechanical insult. This theory fails to explain the occasional occurrence of ulcers near the greater curvature. Von Bergmann is of the opinion that the same neurogenic factors which cause gastric erosions also lead to ulcer formation and calls attention to the frequency of vegetative stigmata in ulcer patients and their tendency to vasomotor instability.

The disappointing feature of studies in gastroduodenal ulcer has been the failure to produce experimentally the clinical equivalent of a chronic ulcer. Gastric erosions and catarrh have been produced by injection of the gastric vessels with lycopodium, by electrical irritation of the vagus nerves and by administration of picrotoxin and pilocarpin. However the lesions have always been superficial and characterized by a marked tendency toward rapid healing. These experiments are nevertheless of interest in demonstrating that pathological changes in the stomach may be induced by different methods. They coincide with the view expressed by Orator and Metzler that the various theories of ulcer are not necessarily contradictory but can be made to accord with the empirical facts of ulcer surgery.

#### PATHOLOGY

One of the most interesting features of the pathology of gastroduodenal ulcer is a study

of site of predilection. Of the 81 cases of gastric ulcer the lesion in 77 cases was found in the pars media. In 34 of these cases the lesion was located on the lesser curvature in 30 on the posterior wall and in 3 on the anterior wall. There were 4 instances of ulcer of the pars pylorica.

The duodenal ulcers were distributed in circular fashion around the first portion of the duodenum as a rule within centimeters of the pylorus. In 54 per cent of the cases the ulcers were multiple. This was particularly true of the ulcers of the anterior wall which were associated with posterior wall ulcers in 18 per cent of the cases. In many instances the ulcers which were found along the lesser curvature of the duodenum extended along the anterior and posterior walls of the duodenum in saddle fashion. The cases of pyloric stenosis were invariably due to cicatricial contraction of the duodenum resulting from the healing of confluent duodenal ulcers. There were no ulcers in the infrapyloric portion of the duodenum.

Since in 17 cases there were ulcers in both the stomach and duodenum a single etiology for both gastric and duodenal ulcer was therefore suggested. The position of the ulcer differed in no wise from those previously described.

In 10 cases the jejunal ulcers were situated as described by Charni (8) along the mesenteric border of the jejunum at a point opposite the gastroenterostomy toma. In 6 cases the ulcer was in the efferent loop and in 4 cases in the afferent loop.

In addition to the findings in the stomach and duodenum the perigastric change was also of considerable importance. Practically all cases showed an enlargement of the lymph nodes along the lesser and greater curvature irrespective of whether the ulcer was in the stomach or duodenum. The enlargement was usually most marked toward the pylorus and all of the cases were associated with a certain degree of perigastritis and periduodenitis. The ulcers of the posterior wall of the stomach were frequently adherent to the pancreas in many cases there being a perforation of the base of the ulcer into the substance of the pancreas. The ulcers of the lesser curvature of the stomach were associated with inflammatory

changes in the gastrohepatic omentum. The ulcers of the lesser curvature of the duodenum were often accompanied by such extensive inflammatory changes in the hepatoduodenal ligament as to cause serious distortion of the common bile duct.

The gall bladder was routinely examined in all cases and 7 instances of cholecystitis with cholelithiasis were found. Two cases were associated with gastric ulcer and 5 with duodenal ulcer. Five of these patients were women and 2 were men. From these findings it is hardly probable that cholecystitis bears any causal relationship to the development of ulcer.

The appendix was not examined except in rare instances inasmuch as Haberer does not consider it to be of any etiologic importance in the production of gastroduodenal ulcer.

No instances of epigastric hernia were noted and it is not conceivable that their presence could have been overlooked as a median supra umbilical incision was used in all cases.

Histological studies were made of the gastric mucous membrane in 100 cases. In every instance there was an extensive inflammatory change in the mucosa of the pars pylorica whereas the mucosa of the partes media and cardiaca was free from histological abnormalities except when the section was taken from the immediate vicinity of an ulcer. These findings confirm the reports of Stoerk (36), Konjetzny (19), Orator (6) and others.

On account of the renewed interest which the work of Konjetzny has stimulated in the possible relationship of gastric erosions and gastroduodenal ulcer, all specimens were examined for the presence of erosions immediately after operation. As is shown in Table I, erosions occurred in a considerable percentage of cases. As these erosions were invariably on a background of a catarrhal gastritis the condition is designated here as a gastritis erosiva. In addition, there were specimens which presented acute ulcerations of recent origin and this finding has been given the name of gastritis ulcerosa.

TABLE I

	N	f	G	t	P	G	t	l	u	s	P	t
(gastric ulcer)	68	18	26	9	13	1						
Duodenal ulcer	163	31	18	17	10	0						
Jejunal ulcer	19	3	20									

In analyzing the group of gastric ulcers associated with erosions it is interesting to note that one half of the ulcers were of the non callous variety. It is of greater import however that there were no instances of non callous ulcer unaccompanied by erosions or superficial ulcerations. It seems plausible therefore to assume that gastric erosions are of significance in the development of non callous gastric ulcers and of secondary importance for the production of callous ulcers.

In the groups of gastric ulcers there were 3 cases which showed malignant degeneration along the ulcer margin. All of these cases were situated in the pars pylorica which in the experience of the Graz clinic is the favorite site of localization for gastric carcinoma. Roentgenologically all of these cases had shown a typical niche. Histologically the specimens showed the characteristic ulcer defect in the muscularis with partial infiltration of the ulcer margin by carcinomatous cells. There were no instances of malignant degeneration of duodenal or jejunal ulcer.

# INCIDENCE

The incidence according to age and sex is shown in Table II. Among the gastric ulcers there were 10 instances of hour glass stomachs and 9 of these occurred in women. The majority of patients under 30 years of age were males with duodenal ulcer.

TABLE II — AGE AND SEX

Age	0-3	30-4	40-5	50-6	60-7	70-8	T
Gastric							
M		6	4		4		47
F			7	3			14
T							8
Duodenal							
M		46	4	3	7		47
F		3	3	7	5		56
T							
Gastric							
M				6	3		3
F							4
T							7
Jejunal							
M		7	1	5	3		8
F							
T							

# SYMPTOMATOLOGY

There was nothing of unusual interest in the clinical symptoms. The greater number of patients were ill for a period of over 3 years prior to operation. The patients with gastric

ulcer or ulcer of the posterior wall of the duodenum showed a tendency to hematemesis and melena. There were no factors in either the habits or personal history of the patients to which an etiological significance for the production could be ascribed. Many cases presented a family history of gastric disturbances suggestive of ulcer. One man who was operated upon for a duodenal ulcer related that his father and two brothers had been similarly operated upon. Another male patient was operated upon for gastric ulcer in 1906 and in the following year his two brothers underwent similar operations at Graz.

#### GASTRIC ACIDITY

Gastric acidity was determined by examining the stomach contents one half hour after a meal of tea and rolls. Although there were many cases of marked hyperacidity this finding was by no means constant. As a general rule the acid content was higher in cases of duodenal ulcer than in cases of gastric ulcer. Studies of the acid content of the stomach after gastric resection showed either a total absence of free hydrochloric acid or else greatly reduced *titre*.

#### ROENTGEN STUDIES

Except in those instances in which roentgen examination was contra indicated because of recent hemorrhage or the fear of impending perforation every patient was subjected to routine fluoroscopic examination after the ingestion of a barium meal. Films were made only in rare cases and purely for purposes of record. The presence of a niche was demonstrated in 97 per cent of the cases of gastric ulcer. The diagnosis of duodenal ulcer was made on the basis of persistent duodenal deformity and the presence of a niche which was found in 98 per cent of the cases. In the group of jejunal ulcers which have always presented a difficult problem for roentgenological diagnosis direct evidence of the existence of an ulcer was obtained in 10 out of a total of 18 cases.

Prior to discharge all cases were reexamined fluoroscopically so that the functioning of the anastomosis could be studied and the size of the stomach observed.

#### TECHNIQUE

In 1905 to April 1915 ether anesthesia was usually employed although a small group of cases were operated upon under infiltration anesthesia of the anterior abdominal wall. Since that time local and splanchnic anesthesia have been used in practically every case except in those cases in which the presence of adhesions resulting from a previous operation made its use inadvisable. The anesthetic solution was a 0.25 per cent solution of tutocain to which a small amount of adrenalin had been added. The technique used was that described by Braun (6). One hundred cubic centimeters were injected for the splanchnic anesthesia. In virtually all instances the anesthesia was entirely satisfactory and free from untoward results excepting a transitory drop in blood pressure. The immediate postoperative effect was much better than in the patients operated upon under ether anesthesia.

In Table III the four operative methods are listed so as to show which methods were employed in the various forms of ulcer. Three patients with gastric ulcer and four with duodenal ulcer had previously undergone gastroenterostomy.

TABLE III—OPERATIVE METHODS

	G	g	D	I	Id	IJ	T	T
Bil	th I			5	6	7		
Bil	th II b			5	2	4		59
Bil	th III t				5	3		59
Bil	th III tro			5		6		6
T t			8	6	7			84

The Billroth I method which is in vogue at Graz has been described by Orator (27). It is employed in every case in which there is sufficient serosa on the posterior wall of the first portion of the duodenum to insure a safe apposition of serous surfaces for the anastomosis. The stomach and duodenum are united end to end without closing the upper part of the cut end of the stomach as originally done by Billroth. This operation is unquestionably the most physiological of all types of gastric resection. It reestablishes the normal continuity of the gastro intestinal tract and as roentgen studies have shown favors the develop-



but only those patients in whom the abdominal findings were completely negative are listed as having died of pneumonia

#### FOLLOW UP RESULTS

In conducting the follow up a card was sent to each patient who had been operated upon requesting him either to report at the out patient department or to answer in writing as to the state of his health. Of the 57 patients to whom cards were sent 40 had moved and could not be traced and 38 failed to reply. In other words follow up results were obtained from 179 patient. As this was the first attempt at systematic follow up it was to be expected that a considerable number of cases would not be located.

The results have been divided into three groups i.e. excellent fair and poor. The patients who were completely free from pre operative symptoms were put in the first class. Those who stated that they were greatly improved but still had occasional symptoms were classed as having a fair result. Those who developed jejunal ulcers or else reported that they were no better than before the operation were considered to be poor.

Of the 54 patients who were operated upon for gastric ulcer and from whom replies were obtained 45 were found to be in excellent health. The majority of these patients had gained over 15 pounds in weight 12 had gained over 25 pounds and 5 had gained over 40 pounds. These patients unanimously praised the successful outcome of the operation and stated that they had never felt better and that they were able to conduct their daily duties in a perfectly normal manner. They were able to eat everything without restrictions and could even drink beer and wine without gastric distress. The 9 patients who were classed as having fair results complained chiefly of distress after drinking milk or eating sweet foods. Others were unable to eat a heavy meal without a sense of discomfort and weakness. These latter symptoms are undoubtedly due to the reduced size of the stomach so called microgastria but the inability to tolerate milk and sweet foodstuffs cannot be so readily explained. There were no instances of jejunal or recurrent ulcer. At this

point it is desirable to recall that of the 81 cases of gastric ulcer 77 were operated upon according to the Billroth I method.

The results of gastric resection for duodenal ulcer are probably of greater interest than the statistics for gastric ulcer because duodenal ulcer is considered the most satisfactory indication for gastro enterostomy by the advocates of this operation. Replies were obtained from 107 cases. Three patients had died of intercurrent disease. Of the remainder 83 were classed as excellent 16 as fair and 5 as poor. It is not necessary to report on the first group further than to say that they were completely symptom free. The average gain in weight was not as great as in the class of gastric ulcer patients who had reported similarly good results. Although there were 2 patients who had gained 55 and 60 pounds respectively the majority of patients gained only between 5 and 15 pounds. The patients who had fair results complained mainly of indigestion after eating certain foods or after a heavy meal. Of the 5 patients who had poor results 2 developed gastrojejunal ulcers.

#### CASE REPORTS

The first patient, a man aged 42 upon whom an antecolic Billroth II resection was performed on February 4, 1925. He was symptom free for 4 months and then developed periodic epigastric pains which gradually increased in intensity. He was readmitted to the hospital on April 20, 1926. Gastric analysis showed a free acidity of 4 and a total acidity of 14. Roentgen examination showed a niche opposite the gastro enterostomy stoma and this was confirmed at operation on April 24, 1926 when a jejunal ulcer was found along the mesenteric border of the jejunum at the point visualized roentgenologically.

The second patient, a man of 51 gave a history of periodic gastric pains of 30 year duration. A gastro enterostomy performed in 1904 was followed by 6 years of relief. At operation on February 7, 1925 an ulcer of the superior border of the first part of the duodenum was found. In spite of the fact that the gastro enterostomy stoma showed moderate inflammatory changes a Billroth II was performed. The previous gastro enterostomy stoma being used. Following operation the patient was free from all symptoms for one year and gained 45 pounds in weight. At the end of that time he suddenly developed pains heartburn and shortly thereafter melena. At operation on December 29, 1926 a jejunal ulcer was found along the mesenteric border of the jejunum opposite the gastro enterostomy stoma. On account of the former operative findings it is reasonable to

assume that this ulcer was simply the extension of previous pathological changes

The third patient was a man of 45 who had had gastric disturbance for 5 years. At operation on January 22, 1926, an ulcer of the anterior and posterior wall of the first part of the duodenum was found. A Billroth I with a terminolateral anastomosis was performed. The postoperative course was complicated by persistent vomiting which lasted for 6 weeks. Ten months later the patient was readmitted with a history of pain and vomiting of 4 months duration. The roentgen examination was negative; the gastric analysis showed a total absence of free hydrochloric acid; the blood Wassermann was negative. At a second operation on December 17, 1926, many adhesions were found between the stomach and the anterior abdominal wall, but the anastomosis was large and normal in every way. The adhesions were divided and the abdomen was closed. Following the operation the patient continued to vomit in small amounts almost daily. Roentgen examination was repeated with negative findings. The neurologist who saw the patient in consultation was of the opinion that the patient's symptoms were functional in origin and the expression of an anxiety neurosis. In January, 1928, the patient reported by letter that he was still suffering from gastric symptoms with nausea and vomiting.

The two remaining patients who had poor results following operation were likewise neurasthenic individuals. One of them had been operated upon previously and a gastro-enterostomy performed. At reoperation a superficial ulcer of the anterior wall of the first portion of the duodenum was found and a Billroth I resection gave only temporary relief.

Follow-up results were obtained from 10 patients in whom both gastric and duodenal ulcers were found at operation. These results were uniformly excellent.

As shown in Table III, there were 20 operations performed for jejunal ulcer. One patient was operated upon 3 times for recurrent jejunal ulcer and a second patient twice. These cases have been reported fully by von Haberer (15). In this series of 17 cases there were 3 deaths. As 5 patients could not be located and 1 patient failed to reply, the results can only be given on 8 patients. Of these patients 6 reported that they were in excellent health and completely symptom free. One patient developed pain 6 months after operation and the findings of roentgen examination were suggestive of the presence of a jejunal ulcer. The other patient developed sudden hematemesis 7 months after operation, but as he was also suffering from hepatic cirrhosis, the bleeding may have been due to esophageal varices.

TABLE VI—RESULTS OF OPERATION

	N	I	P	E	L	T	I	R	P
Gastric ulcer	54	45	9	0					
Duodenal ulcer	107	93	16	5					
Gastric and duodenal ulcer	10	10	0	0					
Jejunal ulcer	8	6	1	2					
Total	179								

## CONCLUSIONS

The Billroth I method of gastric resection is recommended as the operation of choice for the surgical treatment of gastroduodenal ulcer unless technical difficulties prevent its use. In a series of 150 cases there was no instance of recurrent or jejunal ulcer, thus confirming the opinion of von Haberer on the basis of a larger series of 1200 cases. It is believed that the reported recurrences after Billroth I resections are due to the fact that an ulcer of the posterior wall has been overlooked or else to the establishing an anastomosis in an inflamed area of stomach or duodenum.

There was one instance of jejunal ulcer in a series of 75 Billroth II resections.

The follow-up results after resections for gastroduodenal ulcer show that 96 per cent of the patients were completely symptom free or tremendously improved.

The author wishes to thank Professor von Haberer for the many courtesies extended to him and Doctors Orator and Metzler for the privilege of using the results of their pathological studies.

## BIBLIOGRAPHY

1. ABERCROMBIE, J. Pathology and Practical Research on Diseases of the Stomach. Edinburgh, 1830.
2. ASCHOFF, Vorträge über Pathologie. Gustav Fischer, 1925.
3. BALFOUR, Surg. Gynec. & Obst. 1914, vii, 528.
4. BERGMANN, Muenchen med. Wchnschr. 1913, iv, 169-174.
5. BILLROTH, Wien med. Wchnschr. 1881.
6. BRAUN, Local Anesthesia.
7. BROUSSAIS, Thèse, Paris, 1823.
8. CHIARI, Arch. f. klin. Chir. 1925, cxxiv, 99-732.
9. COURVOISIER, Verhandl. d. deut. ch. Gesellsch. f. Chir. 1883.
10. CROUVELIER, Anatomie Pathologique du Corps Humain.
11. DOYEN, Congrès français de chirurgie, 1893, 409.
12. FISCHBERG, A. von, Wie. klin. Wchnschr. 1910, ii, 44.
13. GUST-BAUER and WINWARTER, Arch. f. klin. Chir. 1876, xi.
14. HABERER, Zentr. bl. f. Chir. 1922, xlix, 1321, 1326.
15. Idem, Arch. f. klin. Chir. 1927, cxl, 1, 651, 684.
16. HACKER, Stomach Operations at Billroth's Clinic, 1881 to 1895.
17. HOFMEIER, Beitr. z. klin. Chir. 1911, lxxx, 638.



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## THE RELATION OF THE HISTOLOGICAL STRUCTURE TO THE PROGNOSIS OF THE CARCINOMATA OF THE UTERINE CERVIX

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D p (m) I P h l g L i U S h l f m d d L b I M y l p l

In recent years definite relations between the histological structure and the prognosis of carcinomata have been established through the methodical investigations of several workers. The pioneering work was performed by Broder (3-7) who divided the carcinomata of the skin into four groups according to their degree of differentiation and found a definite relationship existing between this scale of histological malignancy and the percentages of cures obtained in the different groups. He also extended his studies to carcinomata of various organs and obtained similar results.

Martzflof (23) classified the primary solid carcinomata of the uterine cervix into three groups according to the predominating cell type present (spindle cell transitional cell and spinous cell) and reported that the percentages of cures increase with the maturity of the type of carcinoma. Greenough (13) who studied the carcinomata of the breast divided these tumors into three groups according to the degree of differentiation and anaplasia and also stated the existence of definite relations between the histological structure and prognosis of the carcinomata of the breast. In communications of Lahn (4), Cordua (8), Regaud (30) and others similar statements are made confirming these findings. While these workers restricted their

investigations to a study of the structural and cellular condition of the parenchyma of the tumor, McCarty (4) examined the relation of the stroma to the prognosis. From a study of the carcinomata of the stomach he concluded that the life expectancy is increased when the stroma is hyalinized or fibrotic and when it contains a marked lymphocytic infiltration.

In a previous paper (16) I described a method of determining histological malignancy of carcinomata of the uterine cervix by a numerical evaluation of 9 different factors recognized as characteristics of differentiation and anaplasia. In this system only histological features pertaining to the parenchyma were considered. Recently I have attempted to improve this method by increasing the number of factors from 9 to 20 including also those belonging to the stroma. The results of this study are contained in the present communication.

The list of the 20 factors considered is as follows: (1) special cell type of carcinoma (2) nucleocytoplasmic coefficient (3) number of penile cells (4) infiltrative growth of cells (5) general type of carcinoma (6) irregularity in size of cells (7) irregularity in shape of cells (8) distinctness in outline of cells (9) chromatism of cytoplasm (10) functional activity of cells (11) irregularity in size of

nuclei (12) irregularity in shape of nuclei (13) chromatism of nuclei (14) hyperchromatism of nuclei (15) number of mitoses and prophase (16) irregularity of mitoses (17) character of stroma (18) vascularity of stroma (19) type of cellular infiltration of stroma and (20) amount of cellular infiltration of stroma

#### DEFINITIONS AND TECHNIQUE

1 *Special cell type of carcinoma* The carcinomata of the uterine cervix were classified according to their general structure and the maturity of the predominant cell type into two main groups the glandular carcinomata and the primary solid carcinomata and each of these was subdivided into four sub groups

##### A Glandular carcinomata

- 1 Malignant adenoma
- 2 Papillary and gelatinous adenocarcinoma
- 3 Adenocarcinoma simplex
- 4 Solid adenocarcinoma

##### S Primary solid carcinomata

- 1 Spinous cell carcinoma with cornification
- 2 Spinous cell carcinoma without cornification
- 3 Round cell carcinoma
- 4 Spindle cell carcinoma

Carcinomata of sub groups 1 were evaluated with 1 point those of sub groups 2 with 4 points those of sub groups 3 with 6 points and those of sub groups 4 with 8 points

2 *Nucleocytoplasmic coefficient* The relative number of these carcinoma cells which showed a large nucleus surrounded by a small amount of cytoplasm was estimated. If 10 per cent or less of such cells were among the tumor cells 1 point was counted. Their presence in from 10 to 20 per cent was evaluated with 2 points in from 20 to 30 per cent with 3 points and in more than 30 per cent with 4 points

3 *Number of pencil cells* Pencil cells described by Lahm (20) as slender cells with dark stained nuclei invading and destroying the carcinoma cells were counted with 1 point when they were very numerous. Two points were evaluated when they were present in moderate number 3 points when

they were scanty and 4 points when they were completely absent

4 *Infiltrative growth of cells* The presence of well defined outlines in the majority of the carcinomatous cell nests was evaluated with 1 point diffuse invasion present in from 25 to 50 per cent of the cell strands with 2 points in from 50 to 75 per cent with 3 and in more than 75 per cent with 4 points

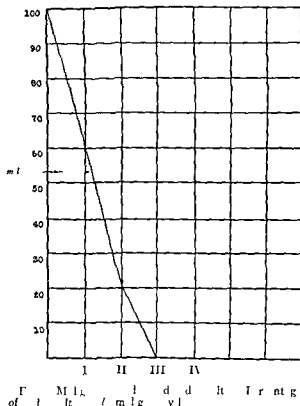
5 *General type of carcinoma* If 75 per cent or more of the carcinoma was composed of parenchyma and if 25 per cent or less was stroma 4 points were counted if from 50 to 75 per cent was parenchyma and from 25 to 50 per cent was stroma 3 points were evaluated if from 25 to 50 per cent was parenchyma and from 50 to 75 per cent was stroma 2 points and if 25 per cent or less was parenchyma and 75 per cent or more was stroma 1 point was counted

6 and 7 *Irregularity in size and shape of cells* The average size and shape of the tumor cells were studied. Deviations from this size and shape respectively in from 40 to 50 per cent of the cells was evaluated with 4 points in from 30 to 40 per cent with 3 points in from 20 to 30 per cent with 2 points and in less than 20 per cent with 1 point

8 *Distinctness in outline of cells* Distinct outlines present in 75 per cent or more of the tumor cells were evaluated with 1 point in from 50 to 75 per cent with 2 points in from 25 to 50 per cent with 3 points and in less than 25 per cent with 4 points

9 *Chromatism of cytoplasm* If the majority of the carcinoma cells had an almost unstained cytoplasm while the connective tissue cells were distinctly pink stained 4 points were counted. If the cytoplasm was only slightly pink stained 3 points were evaluated a moderately pink stained cytoplasm was given 2 points and a distinctly pink stained cytoplasm 1 point

10 *Functional activity of cells* Granules of keratin and droplets of mucous respectively present in less than 10 per cent of the tumor cells were evaluated with 4 points functional activity present in from 10 to 20 per cent of the cells with 3 in from 20 to 30 per cent with 2 and in more than 30 per cent with 1 point



**11 and 12 Irregularity in size and shape of nuclei** The same few points and percentages were used in the evaluation of this factor as described for 6 and 7

**13 Chromatism of nuclei** Four points were evaluated if the majority of the nuclei of the tumor cells had nuclei almost as distinctly stained as those of lymphocytes 3 points if they were somewhat paler 2 points if they were considerably fainter stained and 1 point if they were very pale

**14 Hyperchromatism of nuclei** If 0 per cent or more of the nuclei were as dark stained as those of lymphocytes the factor was evaluated with 4 points if from 15 to 20 per cent were hyperchromatic 3 points were counted if from 10 to 15 per cent 2 points and if such nuclei were present in less than 10 per cent 1 point was counted

**15 Number of mitoses and prophase** The mitotic figures and prophases in 10 fields (oil immersion 1050 x magnification) were counted Twenty or more mitoses and prophases were given 4 points 15 to 19 3 10 to 14 2 and 0 to 9 1 point

**16 Irregularity of mitoses** Pathological types of mitoses present in less than 10 per cent of the mitotic figures were counted with 1 point in from 10 to 20 per cent with 2 points in from 20 to 30 per cent with 3 points and in more than 30 per cent with 4 points

**17 Character of stroma** A very loose oedematous connective tissue stroma was given 4 points a moderately loose one 3 a fibrous one and a fibrous one with extensive hyalinizations 1 point

**18 Vascularity of stroma** A highly vascular stroma was given 4 points a moderately vascular one 3 slightly vascular one 2 and one with very scanty vessels 1 point

**19 Type of cellular infiltration** A predominantly eosinophilic infiltration of the stroma was evaluated with 1 point one mainly composed of lymphocytes mixed with some eosinophilic leucocytes points one consist of lymphocytes plasma cells and scanty neutrophilic leucocytes 3 points and one predominantly composed of neutrophilic leucocytes 4 points

**20 Amount of cellular infiltration** A dense cellular infiltration of the stroma was evaluated with 1 point a moderately dense one with 2 points a slight one with 3 points and a very scanty one with 4 points

#### RESULTS OF STUDY

The number of histological malignancy indices determined was 8 belonging to 226 different excisions Two excisions each contained two carcinomas belonging to different main groups The patients from whom these tissues were removed were admitted during the years 1922 to 1927 inclusive In Table I the 8 malignancy indices are shown from a pathological viewpoint

#### MALIGNANCY INDEX AND END RESULTS

The clinical value of the malignancy index was tested by a comparison of the malignancy index with the end result The clinical end results were graded by Schmutz (16) in the following manner: end result 1 when the patient was free of symptoms and showed anatomical healing 3 years after the beginning of treatment end result 2 when the patient lived for 2 or 3 years after the begin

TABLE I—MALIGNANCY INDICES IN 228 CARCINOMATA\*

Cell type	A	g m h g n c y	R g	N m b o f c
A	42 5		40-45	2
A4	50 7		43-61	10
A6	53 7		47-64	4
A8	6 8		47-79	3
S2	49 6		39-62	8
S4	50 8		34-70	5
S6	58 1		41-73	33
S8	65 7		45-76	25
A2 and S2	46 0.3		39-62	10
A4 and S4	50 75		34-70	6
A6 and S6	55 90		41-73	107
A8 and S8	64 25		45-79	50

Cell types d g t d by th l t A p e s t g l a d u l a r i n m t  
d th by th l t S p m y l d m t a t h m b e d s  
b b t t f t h m l e v l t f t h b g r p s a d t h e d s

ning of treatment end result 3 when the patient lived for 1 or 2 years after the treatment was started and end result 4 when the patient lived for a year. The end results were known in 48 cases. From this group those cases were excluded in which the carcinoma was already generalized that is in which a frozen pelvis or distant metastases were present at the time treatment was started on account of the invariably infaust prognosis. The 48 available cases were divided into 4 groups according to their malignancy index. The first group included carcinomata with a malignancy index ranging from 22 to 39 the second those from 40 to 54 the third those from 55 to 69 and the fourth those from 70 to 84. After determining the percentages of end result 1 in the different groups the following relations were found. There was no case with a known end result in the Group 1 in Group 2 with 13 cases an end result 1 was obtained in 61.5 per cent in Group 3 with 8 cases an end result 1 was recorded in 28.5 per cent and in Group 4 with 7 cases an end result 1 was not obtained in a single instance. The diagram in Figure 1 illustrates the relation between malignancy index and prognosis. The 'malignancy line' follows the percentages of end results of the four groups.

#### STROMA INDEX AND END RESULTS

Studying the relation between the condition of the stroma and the end result I evaluated the stroma from the standpoint of its

Endr result	I	II	III	IV	Number of Cases
1 3 5	15	6	4	1	6
2 6 9	3	4	5	10	22

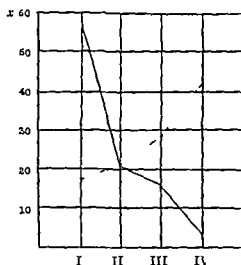


Fig. 1. Parenchyma stroma coefficient and end result 1. Percentages of cases — parenchyma stroma coefficient from 1 3 5 parenchyma stroma coefficients from 2 6 9

antiblastic character. The resulting stroma index represents the sum of an evaluation of the factors 4, 5 and 17 to 20 of the malignogram. A hyalinized stroma was evaluated with 4 points, a fibrous one with 3, a moderately loose one with 2, and a loose one with 1 point. The total range of the stroma index is from 6 to 24. The average stroma index of the 17 cases with end result 1 is 14.8 ranging from 11 to 21; the average stroma index of cases with end results 2, 3 and 4 is 1.6 ranging from 8 to 18. The stroma index apparently shows a certain relation to the end result.

#### PARENCHYMA STROMA COEFFICIENT AND END RESULTS

I also attempted to ascertain the relation between the blastic properties of the parenchyma and the antiblastic qualities of the stroma to the end results. For this purpose I used a parenchyma index, the sum of the evaluations of the factors 1 to 16 of the malignogram. The ratio of parenchyma index to stroma index represents the parenchyma stroma coefficient. The parenchyma stroma

coefficients thus obtained were divided into two groups those between 1 and 3.5 and those between 3.6 and 9. From Figure it is evident that the parenchyma stroma coefficient is apt to be low in cases with good prognosis while it is in general high in cases with bad prognosis and rapid course of the disease.

#### MALIGNANCY INDEX AND PROGNOSIS

The prognosis of a carcinoma considered as the local manifestation of disturbance of general nature depends upon numerous factors of different character. They may be inherited or acquired, permanent or transient, local or general, varying in quality and intensity, affecting different organs and appearing at different time. They can be divided into four groups as follows:

1. The malignancy of the carcinoma represented by the infiltrative, destructive and metabolic qualities of the tumor cells.

The endogenous, blastic and antiblastic, local and general properties of the organism pertaining to race, sex, age, hereditary constitution, functional activity of the endocrine gland, tonus of the vegetative nervous system, condition of the reticulo-endothelial system, cellular fermentative and physical and chemical status of the blood, lymph and organs of the body, especially of the affected area.

3. Exogenous factors: (a) which contributed to the origin of the tumor (tar, paraffin, roentgen rays, arsenic, bacterial and parasitic substances and many others of chemical and physical nature). These factors may remain active during the course of the neoplasm or they may become inactive before the tumor becomes clinically manifest and (b) which make their appearance after the tumor growth has become established as intercurrent diseases, changes in nutrition, environment, therapeutic procedures. They may exert a favorable or unfavorable influence upon the vital activities of the tumor and the blastic and antiblastic qualities of the host.

4. Secondary complications produced by the neoplasm of nonspecific nature: (a) Those of mechanical character as due to compression or obstruction of glandular ducts, ureter, intestine, œsophagus, etc. (b) Secondary

infections of the tumor and the surrounding tissue which decrease the general resistance and prove sometime fatal (mediastinitis in œsophageal carcinoma). (c) Resorption of toxic decomposition products from necroses of the tumor.

It is obvious from this compilation of the different factors that the histological malignancy index in which only the potential malignancy of the carcinoma and the local antiblastic forces are evaluated, cannot give definite information about the future course of a single carcinoma. Such knowledge can only be obtained as the result of a consideration of all of the factors already mentioned and probably by others still unknown to us. Not before the histological malignancy index is supplemented by a clinical malignancy index we will be able to determine the prognosis of a carcinoma more accurately and reliably than we can do it at the present time.

#### HISTOLOGICAL STRUCTURE AND RADIOSENSITIVENESS

The detailed histological analysis of the carcinomata of the uterine cervix presented in this paper offered a good opportunity for the study of the correlations which might exist between the histological structure and the radiosensitiveness of the tumors. Withers (37) in a recent paper asked that the pathology should be interpreted in terms of radiosensitiveness and Lihm (20) stated that the radiologist wants information as to the growth tendency of the carcinoma and the defensive reaction of the surrounding tissue on which he may base his considerations in regard to technique and dosage. Regaud (30) noted that a detailed knowledge of the histological character of the tumor may frequently influence the therapeutic radiological technique.

Up to the present time the attempts made to establish these correlations have been so inconclusive and the results obtained by the different workers so divergent that no definite information has been obtained. Dautwitz (10) concluded from his investigations that histological structure and radiosensitiveness do not show any interdependency. Regaud (30) observed a decrease of radiosensitiveness

with increasing immaturity of the carcinoma but could not find any relation between radio sensitivity and the condition of the stroma. Cordua (8) saw considerable variations of the radiosensitivity of inoperable carcinomata of the uterine cervix of the same histological type. He regarded adenocarcinomata as refractory and observed better primary results in carcinomata of a medullary type. Fleck (28) stated that middle ripe carcinomata containing many mitoses growing in large alveoli and possessing a moderate amount of stromal reaction render the best results. Lenz (1) noted also that adenocarcinomata of the cervix were radioresistant. Recurrences occurred in almost all adenocarcinomata. Loeb (22) however asserted that the apparent radioresistance of adenocarcinomata is caused by their location deep in the tissues where they are less accessible to the action of the rays while they are actually more sensitive than spinous cell carcinomata. Lahm (20) reported that he excludes rapidly growing and immature carcinomata from treatment with roentgen rays. He stated further that pleomorphic carcinomata react well while very vascular and medullary ones are not very sensitive to roentgen rays. Boehm and Zweifel (2) noted that carcinomata composed of cells with abundant cytoplasm growing in narrow strands surrounded by young proliferating connective tissue with inflammatory reaction and eosinophilic infiltration give the best results while carcinomata growing in broad columns surrounded by a resting stroma are less susceptible to the action of roentgen rays. They do not recognize the law of Bergonié that unripe and rapidly growing carcinomata are more sensitive than ripe and slowly growing ones as correct and agree in this respect with Adler, Kehrer, Frankl, Lahm and others. Withers (37) reported that carcinomata of a mature type containing many mitoses hyperchromatic nuclei a marked functional activity and a very vascular and loose connective tissue stroma are more radiosensitive than those tumors in which all or some of these features are absent. Cramer (9) also observed better results in carcinomata with a hyperemic stroma than in those with an anæmic one. Adler (1) saw

better roentgen ray effects in mature carcinomata than in those of an immature type. Pemberton (27) however asserted that the cell type is insignificant for the radiosensitivity and that the parenchyma stroma relation is important in this respect. He in turn is contradicted by Alter who stated that the radiosensitivity decreases with the increasing maturity of the carcinoma an assertion which puts him into a juxtaposition to Regaud (30) and Schmitz (33). Roussy and Leroux (31) and Rubens Duval (32) stressed the importance of the condition of the stroma for the radiosensitivity of the carcinoma. The karyokinetic index of Lacassagne and Monrod is not considered as indicative of the radiosensitivity of a carcinoma by most authors including Minoflet and Schrumpf, Pierrou (25), Roussy, Laborde and Leroux (31), Regaud (30), Proust, Delbet (16) and many others.

From this incomplete compilation of references of the literature the existing discrepancies of opinions are evident. Several factors are responsible for this fact for instance:

1. Variations in the interpretation and evaluation of the histological structure of carcinomata by the different investigators.

2. Varying consideration of the clinical aspect as extension, location and macroscopical appearance of the carcinoma.

3. Insufficient consideration of the differences existing in the general condition of the patient as represented by age, state of nutrition, etc.

4. Differences in the radiological technique and dosage used by the different workers. The effects produced by the roentgen rays may be divided into three groups according to the parts affected:

A. Effect on the carcinoma cells

1. Direct photochemical action. (a) Diffuse cytotoxic action producing acute cellular necrosis. (b) Selective cytolethal and cytoregressive action. The cytoplasm shows swelling, oedema, clumping, disappearance of the plasmosomes, vacuolation and fatty degeneration. The nucleus presents increased irregularity and indistinctness in outline, hyperchromatism, and lysis. Disturbance of the mitotic process evidenced by the appearance

TABLE II—HISTOLOGICAL

A p e l l l t and tr t l h f m	Print 6-	I			II			III			IV							
		3 I m	1 a. l	1 a. l	3 8 m	7 l	1 cr a. m	Decr	336 m	1 354 l	1 cr as m	Dec a.	397 m	1 8 m	Inc as	Dec as	1 5 val m	1 dec a. m
p l l l typ f ar in m	-8	6	6		6	6			6	6			8	8			6	
N l cy plasm fi													3				3	
3 N mb f p l l																3		
I filt gr wh f m													4					
5 G l yp f ar in ma														3			3	
B Ch t f y pl m																		
6 I l y f l l																	4	
7 I g lar b p f l l																		
8 D l f l l s													4				3	
Ch m m f y l m																		
F l v f l l s																		
C Ch t f l	6-																	
Irr gul f cl													4					
I gul y h p f l																	4	
3 Ch m m f l														3			3	
H p h m m f l																		
5 N mb f m os d phas		3																
6 Ir g l y f m																	4	
D Ch f t m	6																	
7 Ch f m													3					
8 Vas lar y f tr m					3				3					3			3	
9 Typ f l l l filtr						3			3			3					3	
Am f l l l filtr						3											3	
H l g l m ligu y ind		66			53	55		66				7	7	6	5	66	5	
Cl alg p					3	3												
E d l												4						

of Broeckelmitoses slowing of the mitotic process resulting in congestion of mitoses in the first days following the irradiation and subsequent decrease of the number of the mitotic figures represent the effect upon the proliferative cellular qualities. These degen-

erative changes of the tumor cells are either followed by death of the cells or they represent only a transient stage of lowered vitality from which they may recover if they are not destroyed in this stage by the attack of the defensive forces of the body. Besides these

## MALIGNOGRAM OF TEN CASES

V					VI				VII				VIII				IX				X								
3	4	456 Int 3 m	rv	Inc as	Dec as	354	356 I t s wk	I	D tr	65	I t wks	667 I t wks	In as	D as	639	I t m	674 I t m	I tr as	D tr	83	I t 4 m	45 I t 4 m	I tr as	D tr as	753	I t m	854 I t m	I	D
4	6					4	4			4	4				4	4				6	8				4	4			
4	4														4					4				3	4				
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3						3	3			4	3				4	4				3	3				3	3			
4	3					3	3									3										1			
7	69					56	53	8	6	56	39		8	68	6	5				53	45	8	6	5	37	3	9		
R3	R3					3	3			4	4				4	4				3	3				4	4			
4	4														4	4													

renitent tumor cells there may also exist refractory cells. Waetgen (36) saw after intensive treatment well preserved carcinoma cells and Seidemann (34) reported the presence of carcinoma which had a perfectly normal appearance in the crater formed by the vagi-

nal radiation employed in a case of cervical carcinoma.

2 Secondary effects (a) Modification of growth by increase of the degree of differentiation and stimulation of the functional activity. A basal cell carcinoma may for



instance change into a spinous cell carcinoma a spinous cell carcinoma into one with cornifications an adenocarcinoma simplex into a gelatinous adenocarcinoma etc (b) Retardation of growth due to the impairment of the proliferative qualities of the tumor cells (c) Stimulation of growth in refractory parts of the tumor evidenced by the increase of the histological malignancy or caused by a breakdown of the local or general resistance due to too intensive irradiation This becomes manifest usually in from 6 to 8 weeks after the treatment

#### B Effect on the stroma

1 Primary effects They precede the changes taking place in the parenchyma (Opitz 6) (a) Hyperemia and oedema due to paresis of the vessel wall (b) Proliferation of fibroblasts histiocytes and capillaries (c) Increase of the leucocytic and lymphocytic infiltration A marked primary stroma reaction is regarded as a favorable sign (Quick and Cutler 9)

Secondary effect (1) Fibrosis and hyalinization of the increased connective tissue stroma It surrounds the remaining carcinoma cells with a fibrous barrier An actual choking of the tumor cells by the stroma is asserted by some authors (Opitz 6 Frienkel 1 Teilhafer 35 etc) and denied by others (Hamperl and Schwarz 14 etc) seems to be improbable because the tumor cells recover from the effect of the radiation more quickly than the cells of the stroma (b) Obliteration of the vessels of the stroma after thickening of the vessel wall In recurrences a decrease of the cellular reaction and loosening and decrease of the connective tissue stroma may be observed (Hamperl and Schwarz) Recurrences originating from encapsulated tumor cells will occur if either the malignancy of the carcinoma cells increases or the local and general resistance decreases due to changes of endogenous or exogenous factors

C Effect on the organism in general (a) Changes in the blood They depend upon the extent and vascularity of the radiated area There are changes in the number and ratio of leucocytes and lymphocytes changes in the physical qualities of the blood (sedimentation time coagulation time surface

tension etc) changes in the chemical composition of the blood (calcium and potassium cholesterol and lecithin etc) and changes in the ferment content of the blood (lipolytic and carcinolytic ferments) (b) Changes in the activity of the endocrine glands (c) Changes in the tonus of the vegetative nervous system (d) Changes in the status of the reticulo endothelial system (e) Changes produced by the resorption of toxic decomposition products of the radiated tissue

Ten cases with two or more sections removed during the course of treatment were available for a study and the effects of roentgen rays upon the different histological factors of the malignogram and of the interrelation between radiosensitivity malignancy index and end result are shown in Table II

Among the 20 factors of the malignogram only 8 showed in the majority of the cases a deviation from their original value toward one side The nucleocytoplasmic coefficient was increased after the roentgen ray treatment in 2 cases and decreased in 5 The ratio in points between these two groups was 2:10 The irregularity in size of cells was increased in 1 case and decreased in 6 cases (ratio 1:6) The functional activity of cells was increased in 2 cases and decreased in 4 (ratio 2:8) Irregularity in size of nuclei was increased in 1 case and decreased in 5 cases (ratio 2:9) The number of mitoses was increased in 1 case and decreased in 6 cases (ratio 1:13) The character of the stroma was increased in 3 and decreased in 6 cases (ratio 6:8) The vascularity of the stroma was increased in 2 and decreased in 6 cases (ratio 3:8) The amount of cellular infiltration was increased in 6 cases and decreased in 1 case (ratio 8:1)

The average decrease in points of the carcinomata with malignancy indices between 40 and 54 was 7 points that of 6 carcinomata with malignancy indices between 55 and 69 was 5.5 points and that of 3 carcinomata with malignancy indices between 70 and 84 was 1.7 point

The average decrease in sections removed in the first month after the beginning of the treatment was 8 points that of sections

removed in the second month 5 points that of sections removed in the third to tenth month -17 points

The average decrease of the 2 cases that were cured was 5.5 points while the average increase of the 4 fatal cases was 0.5 points

#### SUMMARY AND CONCLUSIONS

1 A report has been given of a method of numerical evaluation of histological malignancy freed to a large extent from the influence of individual interpretation by the introduction of 20 different factors representing histological qualities of the parenchyma and the stroma of carcinomata

2 The sum of the evaluations or the histological malignancy index possesses a definite relationship to the end result

3 The stroma index or the sum of evaluations pertaining to the antiplastic qualities of the stroma was in general higher in cases with end result 1 than in those with end result 3 and 4 dying in the first 3 years after the onset of treatment

4 The parenchyma stroma coefficient showed a definite relation to the duration of the disease

5 Definite information concerning the course of a carcinoma depends on numerous local and general endogenous and exogenous factors. The histological malignancy index in which only the histological evidence of the malignancy of the tumor cells and the local reaction of the organism is considered can therefore render an approximate estimation of the future course of the disease

6 Radiosensitiveness of a carcinoma decreases with an increase of the malignancy index

7 A malignancy index which remains stationary or shows only minor variations from the value obtained before the beginning of the roentgen ray treatment points to the

presence of a radiorefractory carcinoma while a marked drop of the value of the malignancy index after radiation is apparently indicative of a good radiosensitiveness of the tumor

#### BIBLIOGRAPHY

- 1 ADLER Strahlentherapie 1920 v 758
- BOEHM and ZWIFFEL Zentralbl f Gynaek 1926 i 30
- 3 BROTHERS Med J & Rec 1925 cxvi 133
- 4 Idem Ann Surg 1921 lxxvii 141 1926 l xv 574
- 5 Idem J Am M Ass 1920 lxxiv 6 6
- 6 Idem Arch Surg 1925 vi 43
- 7 Idem Arch Path & Lab Med 19 6 ii 376
- 8 CORDON Strahlentherapie 1926 xvii 680
- 9 CRAMER Strahlentherapie 1926 xvi 644
- 10 DAUTATZ Strahlentherapie 19 5 xxi 153
- 11 DELBET and MENDARO Les cancers du sein Ann de la Clin Chir 1925
- 12 FRAENKEL Quoted by Opitz
- 13 GREENOLGH J Cancer Research 19 5 ix 453
- 4 HAMPERL and SCHWARZ Strahlentherapie 1927 xvii 606
- 15 HUEPFR Arch Path & Lab Med to be published
- 16 HUEPFR and SCHMITZ Strahlentherapie 1927 xvii 600
- 17 Idem Am J Roentgenol 19 6 xvi 30
- 18 LABORDE ROUSSY and PEYRE Bull de l Ass franc p l tude du cancer 19 vii
- 19 Idem J de radiol et d électrol 1924 viii 289
- 20 LAHM Ergebn d med Strahlenforsch 19 3 i 556 Strahlentherapie 1927 xxv 22
- 21 LENZ Am J Roentgenol 19 7 xvii 335
- 22 LOEB J Cancer Research 1922 vii 2 9
- 23 MARTZLOFF Johns Hopkins Hosp Bull 1927 xl 160
- 24 MCCARTY J Lab & Clin Med 192 viii 42
- 25 MINOYET and SCHRUMPF PIERROU Arch d'électricité méd 1923 489
- 26 OPITZ Strahlentherapie xxi 352
- 7 PEIBERTON Am T Obst & Gynec 1926 vii 536
- 8 PLETZ Inaugural dissertation Koemigsberg Ber u d ges Gynaek 1922 vi o
- 29 QUICK and CUTLER Am J Roentgenol 1923 ix 5 9
- 30 REGAUD FORTSCHR a d Geb d Roentgenstrahlen 1926 xxxv 238
- 31 ROUSSY LABORDE and LEROUX Bull de l Ass franc p l tude du cancer 1923
- 32 RUBENS DUVAL Ann de Méd 1914 i 7 Con du Cancer 1923
- 33 SCHMITZ Am J Obst & Gynec 1925 i 5
- 34 SEIDEMANN Strahlentherapie 19 6 xvii 554
- 35 TEHLIABER Muenchen med Wchnsch 1927 lxxiv 1087
- 16 WAETGEN Strahlentherapie 1926 xvii 579
- 37 WITHERS Am J Roentgenol 1923 x 776

## AN EXPERIMENTAL STUDY OF MUSCLE ATROPHY

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F m h P b l g I L b ry f h M o u t s H p l

THERL still remains some conflict of opinion regarding the mechanism of acute muscle atrophy following arthritis and trauma. Most of the standard textbooks of medicine, neurology and pathology dismiss the subject with a reference to the speed with which atrophy can appear after acute arthritis (McCallum, Aschoff, Tilney and Piley, Sachs and Hausman).

French in his *Index of Differential Diagnoses* 1911 states: "The atrophy is sometimes so rapid that some think it cannot be due simply to disuse but must have a neuro-pathic factor also."

In Rost's *Pathological Anatomy of Surgical Diseases* 1923 there is a brief chronological account in which the author states that the widest acceptance has been won by the reflex theory of Brown Sequard. However, he mentions later experimental results incompatible with this theory and concludes that the problem is still unsolved.

Dana's *Textbook of Nervous Diseases* has the following to say: "In inflammations of joints the muscles moving them are affected by a simple atrophy which is called arthritic. The atrophy is probably due in part to disuse and in part it is a reflex trophic disturbance."

In the *Orthopedic Surgery* of Jones and Lovett it is stated that in every synovitis there occurs early an atrophy of muscle which is an essential part of the affection and not a complication. The same condition occurs after fixation of a limb and at times in connection with an injury to a limb not accompanied by frank synovitis and accompanies chronic joint disease as an integral part of the affection.

The study here presented was undertaken at the suggestion of Dr. P. W. Nathan to determine more accurately the relative speed and extent of the various types of acute and secondary muscle atrophy in the hope that the results would cast some further light on the mechanism especially of the arthrogenic type.

Although the mechanism remains unexplained, acute atrophy following arthritis has been recognized since Hippocrates. Before the work of John Hunter 1835 it was generally assumed that disuse of the affected limb was the factor that caused the atrophy. John Hunter wrote: "The lesions that involve the ligaments, the tendons and the aponeuroses particularly those due to sprain (trauma) disturb the functions of the muscles to a greater degree than those that involve the muscle themselves in that such lesions by sympathy cause atrophy and loss of vigor."

Brown Sequard in 1860 first suggested a reflex mechanism. He believed that the efferent vasomotor nerves were stimulated by the irritation of the arthritis with consequent vasoconstriction that caused faulty muscle nutrition.

Thirteen years later Vulpian attempted to prove this by artificially stimulating the efferent nerves. He was unable to demonstrate significant nervous control of the muscle vessels by this means and concluded that the reflex mechanism causing muscle atrophy was not that proposed by Brown Sequard. He then suggested another reflex theory, viz. the irritative joint lesion sends afferent impulses to the muscular trophic centers in the cord and the stimulation of these centers causes the muscle to atrophy. This theory was almost simultaneously enunciated by Paget.

Numerous other theories were suggested at approximately the same time. Sabourin in 1873 announced an elaborate one based on direct extension of the pathological process. He believed that the inflammation proceeded from the joint peripherally to the fibrous muscle sheath thence to the neurolemma, the nerve, the nerve ending and finally the muscle. As late as 1888 Struempell on the basis of microscopic findings believed that the atrophy was due to the extension of the inflammatory process in the joints to the muscles. The inadequacy of these theories was more or less conclusively demonstrated by

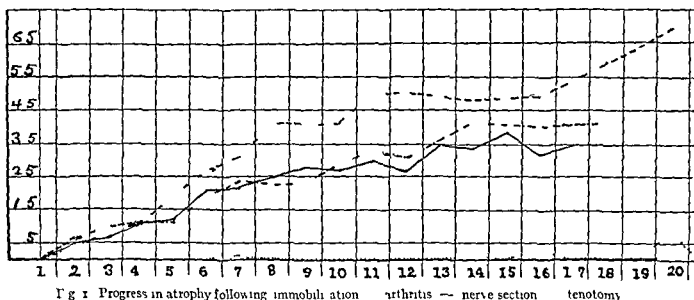


Fig 1. Progress in atrophy following immobilization arthritis — nerve section tenotomy

Duplay and Cazin in 1893. These authors microscopically studied the atrophic muscles as well as the nerves and neurolemma and could find no evidence of inflammatory change. It is not to be denied that acute inflammatory arthritic processes may extend beyond the joint. However the fact that acute atrophy does occur in the absence of such extension is sufficient evidence to show that the extension does not cause it. Also the theories depending on direct extension do not account for the atrophy occurring after aseptic joint lesions which certainly do not spread to surrounding tissues.

In 1877 the first effort to reproduce arthrogenic atrophy in animals was published by Valtat. He produced arthritis in the knees and shoulders of guinea pigs and dogs by traumatizing the joint and by the use of irritating substances. The animals were killed at varying periods thereafter and marked atrophy of the musculature about the joint was found.

Valtat's methods were crude; the muscles were weighed wet and his procedure of weighing entire extremities is a most difficult one to carry out accurately. Nevertheless his work sufficed to demonstrate that acute arthrogenic atrophy occurs in animals and to give some idea of its extent and speed.

Valtat initiated an era of concentration on the subject in France and in 1890 Raymond and Deroche announced that their experiments had proved the reflex theory to be cor-

rect. Raymond produced arthritis in the knees of dogs and cats by cauterization and the introduction of silver nitrate. The animals were killed at varying periods following the injection and the rectus femoris muscle of the arthritic extremity was weighed. The same muscle on the opposite extremity served as a control. He confirmed Valtat's experiments.

In a second group of two animals arthritis was produced in both hind limbs after unilateral section of the posterior spinal roots from the third dorsal to the third sacral segment. The weight of the rectus femoris muscle on the side of the cut roots was much greater than the other side. In fact the weight ratio was similar to that in the first group of experiments. From these experiments it was concluded that the reflex path was essential for the production of acute atrophy. Deroche duplicated and confirmed Raymond's work.

At approximately the same time Hoffa became interested in the problem. It was his first belief that the pathological joint effusion was absorbed through the lymph channels by which route it came into contact with and affected the extensor muscle groups. He tried experimentally to demonstrate the anatomical plausibility of this by injecting the knee joints with colored substances that could later be recognized in the musculature. His experiments showed the substance only in the deeper muscles (vastus). None could be demonstrated in the rectus femoris, a muscle that had been

shown to atrophy after knee joint inflammations Hoffa then in 1908 repeated Paymond and Deroche's work and confirmed their conclusions in every particular

While Hoffa was still engaged in this work Sulzer in a paper published in 1897 maintained that arthritic atrophy could be accounted for by inactivity alone He showed that the muscles spanning ankylosed joints were atrophic as compared with those of the normal leg He also showed that muscles spanning two joints (recti) one ankylosed and one normal were less atrophic than muscles with completely fixed origins and insertions (vasti) This work was done chiefly on cases of chronic arthritis Sulzer concluded then that fixation can produce atrophy His work however does not prove that it can be produced in the short time in which arthrogenic atrophy may appear

Bum a pupil of Sulzer attempted in 1906 to obtain experimental evidence for Sulzer's point of view Bum injected the hip joint of a rabbit with an irritating solution and plinted the opposite side The animal was killed in a few days and the muscle weights were measured The atrophy was more extensive on the splinted side In a second rabbit Bum injected the knee joint of one side and splinted both extremities Muscle weights after several days showed the atrophy to be equal on both sides and on this basis Bum concluded that inactivity was responsible for the atrophy in both cases

Schiff and Zak in 191 continued and elaborated Bum's experiments They quoted the results of Hoffa Raymond and Deroche admitting the correctness of their observations but questioning their interpretation They suggested that in the experiments of these observers atrophy is absent on the side of the sectioned posterior roots because pain sensation is absent and there is no consequent disuse The cutting of the reflex path in itself does not prevent the atrophy but merely obviates pain which when present causes limitation of voluntary function

Schiff and Zak employed both the wet and the dry methods of weighing in their experiments They used chiefly the quadriceps group One extremity of a guinea pig was

immobilized in plaster and the muscles of both sides weighed on the seventh day The results corresponded with Bum's experiments marked atrophy was present on the immobilized side (quadriceps)

But complete inactivity does not always follow arthritis Therefore a second experiment was undertaken to reproduce the effect of partial inactivity The Achilles tendon of a series of guinea pigs was cut on one side This the authors felt produced partial inactivity After 7 to 9 days there was decided atrophy of the entire extremity

In order to eliminate the possibility that a hypertrophy of the opposite leg accounted for the weight difference a third study was undertaken The Achilles tendons of both sides were cut in two dogs On one side of each the knee joint was injected with turpentine After a week the side with the turpentine arthritis and the severed tendon showed only 4 per cent more atrophy than the side that had only the tendon severed Schiff and Zak were satisfied that partial inactivity could produce the same degree of atrophy as knee joint arthritis and that partial inactivity following a painful knee joint was responsible for the subsequent atrophy

The work of these observers may be criticized from several aspects In the first place an insufficient number of animals was employed to insure accurate results Our experiments have shown that many extraneous factors such as plaster bruises and excoriations or even plaster pressure with intact skin may influence to a surprising degree the atrophy of the muscles of the extremities this factor will be further considered in our immobilization experiments Besides the factor of accuracy there are several assumptions which we believe are unjustified That external fixation or immobilization is equivalent to complete muscle inactivity certainly cannot be accepted by us This will be fully discussed at a later period Here it will suffice to say that a muscle immobilized cannot necessarily be considered as being in a state of complete inactivity

Again we may criticize the assumption that atrophy of the muscles following achillo tenotomy is due solely to partial dis

se The possibility that a reflex mechanism is concerned cannot be so easily dismissed

A further study was undertaken by Schiff and Zak namely a repetition of Hoffa's experiments (section of the lumbar and sacral nerve roots on both sides with the production of inflammation of one knee joint) This experiment resulted after several weeks in only 1 to 5 per cent atrophy of the quadriceps on the affected side A control animal in which the posterior nerve roots were cut but the knee joint left intact, showed a similar small amount of atrophy so that in both cases the atrophy was attributed to inactivity by these observers

In the fifth group of animals the dorsal cord was sectioned and one knee joint injected The animals were killed after weeks and the leg muscles of the injected side were 6 to 1 per cent heavier This finding is difficult to reconcile with the reflex theory according to which the greater loss should be on the side of the inflamed knee joint

Schiff and Zak explain that the cord section causes rapid atrophy of both legs but the atrophy on the side of the joint inflammation is delayed by the stimulation of the lower motor neurone reflexes caused by the joint irritation The assumption that the reflex arc preserves the musculature in this case does not imply a trophic factor (These authors believed that the irritation of the musculature produced muscular contraction and thereby prevented the inactivity)

Legg in 1908 reported a further study of muscle atrophy following arthritis Three groups of three rabbits each were employed In the first group one knee joint of each rabbit was inoculated with a suspension of viable tubercle bacilli The same procedure was performed on the second group but in addition the leg was immobilized by means of a tin splint In the third group one leg was splinted but the knee joint not infected The animals were all killed after 40 days and the rectus femoris was measured by the microscopic method (taking an average of the diameters of 300 fibers) His results showed that immobilization alone causes as much atrophy as immobilization plus infection (12 per cent) The group in which the knee joints were in

fectured but not splinted showed less atrophy (7 per cent) than either of the other two groups The atrophy produced by tubercle bacilli (7 per cent in 43 days) is of such small amount that we are not justified in calling it acute atrophy (turpentine atrophy reaches this degree in 2 days)

Legg attributes all these types of atrophy to reflex vasomotor impulses which cut down the blood supply to the affected part We can however find no evidence for this view in the results of his experimental work It will be remembered that Brown Sequard held a similar view but Vulpian failed to produce a marked degree of vasospasm by stimulating the efferent nerves The possibility that such diminution of the blood supply could produce the extreme degree of atrophy that follows acute arthritis certainly does not coincide with our clinical experience (There is for example little or no atrophy following thromboangitis obliterans of long standing)

In 1926 Harding made an interesting contribution to the subject from a different aspect Two parallel series of rabbits were employed in one of which (14 in number) a knee joint arthritis was produced by the streptococcus infrequens In the other series (6 in number) one extremity was immobilized in a plaster spica After 3 weeks the femoral arterial and venous blood was drawn from the animal under anaesthesia and subjected to gas analysis to determine the oxygen consumption in the extremity The animals were then killed and the quadriceps muscle group weighed the opposite side being used as a control

Harding's results showed practically a doubling of the oxygen consumption in the arthritic atrophy cases whereas the immobilized animals showed only a slight increase above normal Harding believed that this difference was due to a higher rate of muscle catabolism in arthritic atrophy than in immobilization and that this indicated a different mechanism of production

Further experimental work along these lines is certainly necessary before Harding's interpretation can be accepted It is possible that the administration of an anaesthetic is a complicating factor Again it may be that any

spastic muscle will give evidence of as great an increase in oxygen consumption regardless of its size diminution. In other words no evidence is presented that the increased catabolism bears any direct relationship to the atrophy.

From this brief summary of the literature upon muscle atrophy it is clear that there still exists a considerable diversity of opinion as regards the mechanism and cause of this condition. There are moreover rather remarkable differences in the results obtained in the experimental work undertaken to clear up the subject and even where the results obtained by experiment are similar the authors are at variance as to their interpretation.

For these reasons we decided to repeat the experimental work that has been done in the hope that by taking great care to have the experimental method accurate and the findings unequivocal we might be able to clarify the subject.

One hundred and eighteen rabbits were used in the study.

The semitendinosus muscle was used for the first three groups of experiments. It was chosen because of the following reasons:

1. It is an auxiliary muscle and therefore its paralysis causes no discernible lameness or disability.

It is a red muscle—completely surrounded by the pale adductor magnus and it can be accurately dissected out.

3. It has a small and well defined origin and insertion which can be accurately dissected or sectioned.

4. It crosses the knee joint and will be affected by pathological processes in that joint.

5. The nerve supplying this muscle is single and can be sectioned by a posterior approach so it leaves the sciatic trunk thus minimizing the possibility of injury to the blood supply of the muscle to the muscle itself.

It was necessary to employ the gastrocnemius muscle for the fourth group (immobilization experiments). As the semitendinosus muscle takes its origin from the pelvis in order to immobilize this muscle it is necessary to immobilize the thigh on the pelvis. In the rabbit it was found impossible to accomplish

this unless the motion of the opposite lower extremity was restricted and this would preclude the use of the opposite member as a control. On the other hand the gastrocnemius can be immobilized by means of a plaster spica without any effect upon the opposite extremity.

To determine the variation that might exist in normal muscles and to determine the more accurate method of weighing to be adopted we dissected and weighed semitendinosus muscles in a series of ten rabbits that had not been operated upon. The muscles were weighed both wet and dry. For the dry weighing the muscles were washed in water and dried for 4 hours in a dry chamber with a constant temperature of 100 centigrade.

By the wet method the average difference between the muscles of both limbs was 7 per cent. by dry weight there was a variation of 2 per cent. From these findings as shown in Table I we considered the dry method of weighing to be the more accurate and this method was therefore used in all the experiments (Table I).

TABLE I—WEIGHTS OF THE DRIED SEMITENDINOSUS MUSCLES IN TEN NORMAL RABBITS NOT OPERATED UPON

R. bb.	R. h. ms.	L. f. c. 6.	D. f.	P.
	98	106	31	3
	63	69	9	9
3	497	56	9	3.8
4	34	5	004	1
5	54	54	00	
6	3	9		6.4
7	339	332	006	
8	487	467		4.1
9	389	388	00	
	379	3	007	2
M. m. m. diff.	c. 64 p.	t. m. m. m. diff. e. e.		
h. pe. e. t.	ag. diff.	h. pe. e. t.	R. h. t.	
e. s. t. m.	l. f. h.	e. r. s. t. m. s.		

#### TECHNIQUE OF EXPERIMENTAL ARTHRITIS

Turpentine was used as the irritant. After iodination of the skin overlying the knee joint the turpentine was injected hypodermatically into the knee joint. For the animals that were to be killed before the third day after the injection 0.75 cubic centimeter was used. 0.5 cubic centimeter was used in those killed on the third day. 0.2 cubic centimeter was used for all animals that were to live.

TABLE II—TURPENTINE ARTHRITIS

m	S d	D i	f t	Am t	W t	W t	W t	D i	A t	A d	g
b	f e t e d	d y	t h	o f	r i g h t	l f t	l f t	f t	h t	h t	h t
1	Right	1	0	75	348	349	0	0	0	0	0
2	Left	2	0	75	282	69	013	4	0	0	0
3	Right	2	0	75	205	282	017	0	5	0	0
4	Left	2	0	75	275	260	015	5	0	0	0
5	Right	3	0	5	232	232	020	8	0	0	0
6	Right	3	0	5	242	257	015	6	6	6	6
7	Left	3	0	5	353	347	036	9	0	0	0
8	Right	4	0	0	377	417	040	9	5	0	0
9	Left	4	0	2	397	345	052	13	10	0	0
10	Right	4	0	2	320	354	034	10	0	0	0
11	Right	5	0	0	496	561	065	11	0	0	0
12	Left	5	0	2	858	752	102	12	12	2	2
13	Left	5	0	2	397	341	0	6	14	0	0
14	Right	6	0	2	235	321	086	26	0	0	0
15	Right	6	0	2	250	295	039	13	21	0	0
16	Left	6	0	2	338	256	082	24	0	0	0
17	Left	7	0	2	103	312	093	23	0	0	0
18	Right	7	0	2	275	370	095	24	0	0	0
19	Left	7	0	2	517	425	094	18	0	0	0
20	Right	8	0	2	286	384	098	26	0	0	0
21	Right	8	0	2	355	470	115	25	5	0	0
22	Left	8	0	2	345	268	076	23	0	0	0
23	Left	9	0	2	472	315	157	33	0	0	0
24	Left	9	0	2	287	373	086	23	28	0	0
25	Right	9	0	2	235	347	09	8	0	0	0
26	Left	10	0	2	438	293	145	33	0	0	0
27	Left	10	0	2	386	296	090	24	7	0	0
28	Right	10	0	0	274	382	108	23	0	0	0
29	Left	11	0	0	436	305	131	30	30	0	0
30	Left	12	0	2	392	295	097	4	0	0	0
31	Left	12	0	2	374	273	106	27	26	0	0
32	Right	12	0	2	288	392	104	28	0	0	0
33	Right	13	0	0	197	290	093	32	34	5	5
34	Left	13	0	2	343	217	126	37	0	0	0
35	Right	14	0	2	420	627	207	33	33	0	0
36	Right	15	0	0	310	515	05	38	38	0	0
37	Left	16	0	2	260	165	095	37	0	0	0
38	Right	16	0	2	182	246	074	26	31	5	5
39	Left	17	0	2	357	227	130	36	0	0	0
40	Right	17	0	2	113	167	054	33	34	5	5

more than 5 days. When a larger amount was used (in the latter groups) the purulent effusion usually broke through the capsule of the joint and infiltrated the musculature of the extremity. (Animals which on autopsy showed extra articular inflammation were not included in this statistical study.)

## TECHNIQUE OF NERVE SECTION

Under ether anaesthesia preceded by a quarter grain of morphine by hypodermic a one half inch incision was made in the direction of the fibers of the gluteus maximus muscle. The fibers of the gluteus maximus and the underlying medius were separated by blunt dissection and retracted and the sciatic nerve

TABLE III—NERVE SECTION

N m	Op t i l e	D t n	W e i g h t m d	W e i g h t l f t m d	D i f f	A t p h y p	D i t p h y p
1	Left	2	328	315	013	4	4
2	Right	3	286	302	017	6	7
3	Right	3	300	340	040	9	5
4	Left	5	405	366	039	9	7
5	Right	5	327	381	054	14	1
6	Right	6	28	358	070	21	19
7	Left	6	544	447	097	18	0
8	Left	7	337	257	081	4	24
9	Right	8	88	375	087	3	3
10	Right	9	265	345	080	3	0
11	Left	9	325	56	061	20	3
12	Left	9	391	94	097	5	0
13	Right	10	343	482	139	29	9
14	Left	11	617	334	233	37	33
15	Right	11	153	201	078	30	0
16	Right	11	200	303	103	33	30
17	Left	12	255	355	100	28	0
18	Left	14	317	182	135	4	42
19	Right	16	102	353	161	45	0
20	Left	16	183	126	057	35	40
21	Left	18	274	163	111	47	41
22	Right	50	182	345	163	53	53

exposed. The nerve to the semitendinosus leaves the sciatic about a quarter of an inch below the sciatic notch and can be easily identified and sectioned. Wounds were closed with silk and a collodion dressing was applied. The posterior approach was used because it is easy of accomplishment and does not endanger the blood supply to the muscle.

## TECHNIQUE OF TENOTOMY

Under ether and morphine anaesthesia a vertical incision was made on the inner side of the leg just distal to the knee joint. The tendon of the semitendinosus was identified and brought into the wound with a blunt hook. It was then sectioned close to its tibial attachment. Wounds were closed with silk and a collodion dressing applied.

## TECHNIQUE OF IMMOBILIZATION

For reasons mentioned above we used the gastrocnemius for these experiments. Immobilization was accomplished by the application of a plaster spica extending from the mid thoracic region to the toes. The plaster bandage was applied directly to the animal without the use of padding. The fur of the animal proved to be adequate protection against pressure sores.



This type of bandage immobilized the thigh  $le_0$  and foot completely

#### EXPERIMENTAL DATA

The results of these four groups of experiments for the sake of brevity are given in tabular and chart form

#### CONTROLS

*Nerve section* In order to ascertain whether the shock of the operation played any part in the atrophy caused by nerve section three animals were operated upon just as for a nerve section except that the nerve was not sectioned. After the nerve was exposed and retracted with the blunt hook it was allowed to drop back into the wound and the wound was closed. The results are shown in Table IV.

Table IV shows that operative trauma played an insignificant part in the amount of atrophy. The possibility that there is additional nerve supply to the muscle was excluded by careful dissections. In no case was an accessory or anomalous nerve supply to the semitendinosus discovered. The atrophy recorded on the chart therefore represents that solely due to nerve section.

TABLE IV—CONTROL EXPERIMENTS FOR THE ATROPHY FOLLOWING NERVE SECTION

N	S d	I	W f m d	W h f h m d	W h f h m d	L	I
I	Rght	5	585	584	003		
II	L ft		383	377	0		3
III	L ft	1	5	5	0		

*Tenotomy* Lipschutz and Audova in their experimental controls incised the tendon itself but did not cut it through. They reported insignificant atrophy following this procedure and concluded that probably the atrophy consequent upon nerve section and tenotomy are analogous and due to the inability of the muscle to function i.e. disuse.

In order to rule out the possibility that the trauma of operation plays some part in the atrophy in our own cases we exposed the tendon and subjected it to friction in three rabbits. As shown in Table VI the atrophy following this procedure was insignificant. Hence it must be concluded that the operative trauma may be disregarded and that the

TABLE V—TENOTOMY OF SEMITENDINOSIS

N	S d	D s	W f m d	W h f h m d	W h f h m d	D s	A o phy pe	A o phy pe
1	Pght	2	348	335	7	5	5	
	L ft	1	16	93	7	8	7	
3	Rght	3	18	194	12	6		
4	Left	4	540	48	03	9	1	
5	Left	4	33	29	036	1		
6	Lght	5	76	27	041	9	19	
7	Lght	6	15	18	057	3		
8	Left	6	33	27	86	27	7	
9	Rght	6	00	67	67	4		
10	L ft	7	3	67	063	3	32	5
	L ft	7	533	395	08	33		
	Left	8	5	50	4	4		
3	Rght	8	95	34	45	42		
4	Left	9	528	315	13	4	42	
	Pght	9	44	9	345	44		
6	Rght		68	5	107	39	4	5
7	Left		9	16	130	44		
8	Rght		17	95	88	46	5	
9	L ft		17		6	54		
	L ft	4	4	16	04	48	4	5
	Lght	4		34	73	47		
	Lght	6	34	6	13	49	47	
	Lght	8	8	64	146	59	59	
23	L ft	0	377	0	257	67	69	
5	Rght	3		490	68	54	54	

atrophy following tenotomy is due entirely to the section of the tendon.

TABLE VI—CONTROL EXPERIMENTS FOR THE ATROPHY FOLLOWING TENOTOMY

N	S d	D s	W f m d	W h f h m d	W h f h m d	L	P
I	L ft	4	336	378	003		
II	Rght	2	47	45	002		
III	Left	4	36	314			3

From the results of the immobilization experiments as shown by Table VII we must conclude that the atrophy if any resulting from immobilization is slow in onset and never reaches the proportions that occur after tenotomy nerve section or experimental arthritis that in fact it is insignificant as compared to the atrophy that occurs in these conditions.

We are unable to account for the findings of previous investigators who have reported muscle atrophy by external immobilization unless we assume that errors in technique are responsible for the atrophy said to have been so induced. In our experiments we found it rather difficult to obtain complete immobilization of the pelvis and hip joint without at the same time producing other lesions. In

TABLE VII—IMMOBILIZATION

d m l i z d	D t	W g h t f g a s t r o c m	W g h t f l f t g a s t r o c m	D f l f t g a s t r o c m	A t o p h y P t	A d i c t o p h y P t	g l y P t
eft	4	3 165	3 173	008	0	0	0
eft	7	2 205	2 223	018	1	1	1
ght	8	2 450	2 380	000	0	0	0
ght	8	1 56	1 59	03	1	1	1
eft	10	1 54	1 59	0	0	0	0
eft	11	52	2 62	10	0	0	0
ght	12	03	2 0	01	0	0	0
ght	14	2 107	2 128	021	0	0	0
ght	14	3 62	3 69	07	2		
eft	16	2 42	3 55	07	3	3	
eft	17	5 45	5 42	03	0	0	
eft	20	2 13	1 93	20	9	9	
ght	21	1 84	1 85	01	1		
ght	30	1 703	1 725	02	1	1	
ght	32	2 00	2 06	06	3	3	

ve found it almost impossible to obtain  
 n of the hip without causing excoria  
 upon either the fixed or the free limb  
 on the other hand we immobilized the  
 cnemius we obtained fixation without  
 complicating factors In these experi  
 the atrophy not only was slow in ap  
 e—did not in fact appear until the  
 tenth day—but was insignificant as com  
 with that obtained in experimental  
 section tenotomy or arthritis Inas  
 as great care was taken to obtain com  
 immobilization our failure to obtain  
 hy in these cases cannot be attributed  
 lre to obtain absolute fixation We  
 conclude therefore that the atrophy  
 ed by others with experimental immo  
 tion was caused not by the fixation  
 it was no doubt due to other extra  
 factors injury excoriation etc such  
 curred in our experiments upon the hip  
 that for this reason we discarded as  
 urate

e think we are therefore justified in con  
 ng that immobilization is not the cause  
 of atrophy in arthritis It does not how  
 w from this that the atrophy that follows  
 experimental arthritis or human arthritis is  
 disuse atrophy As a matter of fact the  
 e muscle atrophy of arthritis may well be  
 e disuse atrophy What we maintain is  
 muscle disuse in such cases is not due to  
 ntary or external fixation of the limb  
 a if we leave out of consideration our  
 mobilization experiments the underlying

physiological factors involved should lead us  
 to this conclusion

If an extremity is immobilized e g in plas  
 ter we fix the origin and insertion of the  
 muscles with reference to each other and by  
 this procedure muscle shortening is inhibited  
 The tension of the muscles however is still  
 under control of the central nervous system  
 and limitless energy may be expended in ex  
 erting muscular force to resist immobilization  
 Under these circumstances there is a con  
 tinued expenditure of muscle energy to pro  
 duce isometric contraction in the immobilized  
 member Obviously then although volun  
 tary shortening is inhibited when the limb is  
 immobilized the muscles in such an extremity  
 still continue to exercise some of their func  
 tions Such muscles cannot strictly speaking  
 be said to be in a state of disuse As a matter  
 of fact complete disuse connotes complete  
 absence of all function Hence although it is  
 possible that partial disuse exists when a limb  
 is immobilized it is not by any means com  
 plete and as has been shown by our experi  
 ments does not lead to atrophy

As a matter of fact a muscle can be said  
 to have completely lost its power to function  
 only when it has completely lost contact with  
 the central nervous system In this case as  
 has been shown by Jamn who's work has  
 been confirmed by many competent observers  
 the function of the muscle is entirely sus  
 pended and it becomes completely relaxed in  
 consequence it undergoes simple atrophy and  
 the atrophy is uncomplicated by any other  
 conditioning influences

The nearest approach to such disuse obtains  
 when the tendon of a muscle has been severed  
 In this case the neuromuscular control is pre  
 served and the muscle continues to receive  
 stimuli to contract either directly or indirectly  
 through its nerve supply but inasmuch as  
 muscle tone cannot be maintained unless the  
 elastic tension is intact the muscle remains  
 relaxed has therefore lost its power to func  
 tion and undergoes atrophy

All proprioceptive stimuli are according to  
 accepted teaching reflex initiated by joint  
 motion and have their receptors not in in  
 dividual but in muscle groups If therefore  
 the tendon of one muscle belonging to a group

that activates a certain joint is sectioned more particularly when the muscle whose tendon has been sectioned is only a subordinate member of the group this muscle will continue to receive its share of tonal stimuli so long as the joint continues to be activated by the other members of the group. Hence such a muscle though still receiving proprioceptive stimuli nevertheless remains in a state of relaxation and for this reason can perform no function. Obviously then nerve section and tenotomy cause analogous functional disturbances in the muscle they are both followed by relaxation in the one the muscle ceases to function because it receives no more nerve stimuli and cannot contract in the other the muscle continues to receive efferent stimuli and may contract but the contraction produces no or only slight increase of tension that is only that caused by resistance of the weight of the muscle itself. In either case the muscle does no work and in consequence undergoes atrophy. Under these circumstances we should expect to meet with a similar type of atrophy regardless of whether the cessation of function is caused by nerve section or tenotomy and this is borne out by our experiments as shown in the tables and charts which for the most part confirm those of Lipschutz and Audouin.

#### EXPERIMENTAL RESULTS

Our experiments with arthritis again show that the atrophy that follows this condition closely resembles these two types of atrophy in practically all particulars. Only after 13 days does arthritic atrophy fail to keep pace with the above mentioned two other types and this is readily explained on the grounds that the irritation of an aseptic substance such as turpentine is limited in duration while nerve section and tenotomy produce more permanent lesions.

In our experiments atrophy was measurable after 48 hours following nerve section tenotomy and acute arthritis. After this time it increased rapidly until the beginning of the second week when a slower rate of progress ensued. On the other hand the atrophy that followed external fixation of the limb was not appreciable until the third week and even

then was not beyond the limit of error except in one case. One rabbit immobilized for 32 days (longest observed period) showed only 3 per cent atrophy which is within our limit of error. Obviously then immobilization atrophy is not comparable in rapidity of onset or in degree with the other types observed.

#### DISCUSSION

The more plausible theories that have been suggested regarding the mechanism of arthrogenic atrophy are the following:

1 Diminution of blood supply through direct pressure of joint effusion on the muscle.

2 Poor muscle nourishment through reflex stimulation of efferent vasomotor nerves (Brown Squire).

3 Myositis by direct extension (Struempell).

4 Ascending neuritis from joint periphery to fibrous muscle sheath to neurolemma to nerves to nerve endings and finally to muscle (Decossé Sabourin).

5 Absorption of the pathological effusion through lymph vessels bringing it in contact with the extensors and affecting them (Hoffa).

6 Disuse caused by fixation of the joint (Sulzer Bum Schiff and Zick).

7 Reflex stimulation of trophic cord centers which directly control muscular nutrition (Paget Vulpian Charcot Lefort and Valtat).

Theories one and two which make use of a blood diminution mechanism may well be discarded because thromboangiitis obliterans and atherosclerosis may exist for years without causing notable atrophy.

Theory number one assumes the existence of joint effusion but this is not always present clinically and in arthritis accompanied by marked atrophy does not account for the fact that atrophy is common in muscles distant from the joint inflammation.

Concerning theory number two it will be remembered that Vulpian by experimental stimulation of the nerve to the musculature failed to demonstrate significant control of the muscular blood vessels by them.

Theories three and four those depending on direct extension of the inflammatory process may also be discarded. Duplay and Cazin failed to demonstrate microscopic evidence of

inflammation either in the nerve or musculature in cases that exhibited arthritic atrophy. And these theories do not account for the atrophy occurring after cases of joint trauma or atrophy at a distance from the affected joint.

Theory number five was discarded by Hoffa himself when he was unable to demonstrate that the lymphatic drainage of the knee joint anatomically approached the quadriceps muscle.

Theory number six is certainly untenable if by disuse is meant limitation of the function of the extremity as a whole. Our failure to obtain acute atrophy in the immobilization group and the physiological conditions concerned is adequate evidence of this. Moreover it is known that in cases of hemiplegia as long standing as 15 years and with more or less complete disuse of the hemiplegic extremity atrophy cannot be demonstrated.

On the other hand if it is definitely understood that more or less complete cessation of function as caused by more or less complete relaxation of the muscle involved constitutes disuse these objections do not apply and disuse in that sense is a plausible explanation of the atrophy.

That muscle relaxation the sign of cessation of muscle function occurs after joint trauma and infection was first recognized by Raymond and subsequently described by Caspary who termed the condition muscle collapse. Lorenz designated it as the first stage of arthritic atrophy and wrote that its duration may be from 12 to 48 hours. As this condition of the muscle for reasons mentioned above cannot be ascribed to the extension of the pathological process to these muscles it must be assumed that it is due to an inhibition or alteration of impulses to the musculature or fatigue due to over stimulation.

At all events it is certain that this muscle collapse represents the earliest neuromuscular phenomenon that presents itself in arthritis and is a condition that resembles in every particular that which ensues when a nerve or tendon is sectioned. It seems therefore only reasonable to suppose that the atrophy following arthritis is analogous to the atrophy of nerve section and tenotomy.

## SUMMARY AND CONCLUSIONS

1 The muscle atrophy that follows the fixation of a limb is small in degree and is not appreciable before the lapse of at least a month.

It is not comparable to the atrophy caused by nerve section, tenotomy and arthritis either as regards its onset or the proportions that obtain in these conditions.

3 The atrophies that follow tenotomy, nerve section and arthritis are extremely rapid in onset and the progression is almost equally as brisk in all these forms.

4 The muscle atrophies that follow tenotomy and nerve section are due to cessation of muscle function and therefore true disuse atrophies.

5 The atrophy that follows experimental arthritis is preceded by muscle relaxation—muscle collapse—and the subsequent course is the same as that which obtains following tenotomy and nerve section. It is therefore reasonable to conclude that arthritic atrophy is also a disuse atrophy. The muscle disuse however is not caused by voluntary immobilization or external fixation but is due to the muscle collapse.

6 Hence the theoretical and experimental evidence leads to the inference that although arthrogenic atrophy must be considered a disuse atrophy it is not due to immobilization but is caused by a reflex mechanism.

## BIBLIOGRAPHY

1. ACHARD C and JEVY I. Atrophie des centes nerveux dans un cas d'atrophie musculaire. *Revue de l'origine articulaire. Nouv. iconog. de la Salpêtrière* Paris 1898 xi 26-275.
2. ASCHOFF L. Pathologische Anatomie section by M. B. Schmidt. Jena Fischer 1923.
3. BRACKETT E G. Atrophy in Joint Disease. Boston M. & S. J. 1891 cxxx 617-619 No 24 Dec.
4. BROWN SÉQUARD C H. Lectures sur les vasomoteurs. Paris 1860.
5. BUM V. Wien med. Presse 1905 no 47 1906 No 41.
6. CASPARY Ref. Monatsch. f. Unfallh. 1897 p 90.
7. CHARCOT J M. Sur l'atrophie musculaire chronique et le rhumatisme articulaire chronique. *Prog. méd.* Paris 1882 p 173.
8. CHAROT J M. Leçons sur les maladies du système nerveux. Bureau du progrès méd. Paris 1887.
9. DANA C L. The book of Nervous Disease. New York William Wood & Co 1925 p 328.
10. DEROCHÉ R. Étude clinique et expérimentale sur les atrophies réflexes d'origine articulaire. *Thèse de doct.* Paris 1893.



# CLINICAL SURGERY

FROM THE DEPARTMENT OF ORTHOPAEDIC SURGERY UNIVERSITY OF IOWA

## THE STRIPPING OF THE OS CALCIS

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**R**ATIATIVE to the treatment of *curvus deformity* of the foot the writer proposed and described in 1917 a method for the relief of the *curvus deformity* so far as it is caused by the contracture of the soft structures within the sole of the foot. The disappointment which followed the usual methods for the relief of this contracture especially of the resection of the plantar fascia justified the advocacy of a method that promised more radical relief. It was used upon the proposition that the soft tissue contracture was caused not only by the shortened fibers of the plantar fascia but also by the structural shortening of the fibers of the short muscles of the foot and furthermore of the septa which arise from the plantar fascia and which divide the soft tissues of the foot into two lateral and one middle compartments. These structures are not likely to yield to simple transection of the plantar fascia even though division is carried to the skeleton.

The method is further based upon the anatomical consideration that the short flexors of the toes originate at the rather circumscribed point at the posterior process of the *os calcis*. These muscles become so intensively interwoven with the plantar fascia that simple fasciotomy does not take care of all contracted elements (Figs. 1 and 3).

### INDICATION

The release of the soft tissue contracture of the hollow foot by the stripping operation is a symptomatic step. In cases in which the contracture is due to the shortening of the soft structures alone this procedure might be sufficient but in all instances in which the skeleton takes part in the deformity the latter must be handled separately after the soft tissues have been released. In such additional procedures as wrenching osteotomy, wedge osteotomy, or tarsotomy according to the case and the degree of the *curvus deformity* (Fig. 2). It should also be realized

that the downward deflexion of the foot occurs largely in the midtarsal and in Lisfranc's joints and not in the ankle joint so that in most instances the *tendo achillis* is not shortened considerably and therefore needs no lengthening. On the contrary in the paralytic hollow foot we find that the *tendo achillis* is usually lengthened and its condition is of prime importance in the pathogenesis of the deformity.

It should be further realized that in paralytic cases as well as in some congenital deformities in which there is an irreparable imbalance of the muscles the restoration of form by the stripping and by the subsequent bone operation is not sufficient to assure a restoration of balance. In such cases it is quite obvious that after the form has been restored additional measures must be considered for the maintenance of muscle balance, i.e. tendon transplantation or more frequently arthrodesis and other stabilizing operations upon the foot.

### TECHNIQUE

A horizontal incision is made over the inner aspect of the *os calcis* forward to a point about 1½ inches in front of the inner tubercle of this bone. Skin and fascia are divided and then the lower or plantar surface of the plantar fascia is dissected from the layer of fat throughout its full width from the inner to the outer border. Then the fascia is incised crosswise close to the point where it blends into the lower surface of the *os calcis*. The muscles covered by the fascia are from the inner to the outer side the abductor of the big toe and the short flexors of the toe and abductor of the fifth toe. These muscles are stripped off the periosteum of the *os calcis* with a blunt instrument. This is necessary since otherwise the stripping of the periosteum might give rise to the extensive formation of bone. It is also necessary to extend the stripping forward until the calcaneocuboid junction is reached on the



## FROM THE ST LOUIS CHILDREN'S HOSPITAL

## THE FREDET-RAMMSTEDT OPERATION FOR CONGENITAL PYLORIC STENOSIS

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A NEW operation for the relief of congenital pyloric stenosis was suggested by Fredet in 1910 and the results of the operation were published by Fredet and Rammstedt almost simultaneously in 1912. Up to this time the generally accepted method of treating infants with pyloric stenosis was to do a gastro-enterostomy. This gave excellent results in cases that recovered but as it required a high degree of technical skill and experience in infant surgery the mortality rate was about 25 per cent even in the hands of the best surgeons. This made the procedure too formidable for use except in the cases in which every detail clearly pointed to a satisfactory outcome and many cases in which operations were not performed because of the fear of postoperative mortality resulted in death.

Since about 1915 the simple operation which we are to describe has been universally adopted because it is easily performed and efficient and has a negligible mortality.

The diagnosis rests on the following signs and symptoms: the spitting up of food beginning shortly after birth and becoming progressively worse until after 3 or 4 weeks the vomiting becomes projectile, the stools becoming less frequent and smaller and in the fully developed case the gastric peristalsis with its bill like waves is evident to even the tyro. In the advanced case the pyloric tumor can be felt when the stomach is empty. The palpation of a tumor was at one time the criterion that settled the question of operation but now we do not think it necessary to wait for the hypertrophy of the pylorus to become so large that it can be distinctly felt before advising operation because while the pylorus is enlarging the stomach is dilating and its wall is thickening because of the increasing work necessary to empty the viscous after progressive stenosis of the pylorus. The late cases with large and thickened stomachs are handicapped in their recovery because of the time required for the overworked stomach to return to normal.

Most of these cases are brought to the hospital markedly dehydrated and at times showing alkalosis. To overcome these conditions abun-

dant subcutaneous injections of Ringer's solution are necessary. If athrepsia is present glucose solution intravenously or whole blood transfusion is indicated. We regard the preparation of the patient for operation as one of the most important factors in the handling of these cases. Frequently 18 to 24 hours is given to the replacing of fluid loss and the counteracting of starvation symptoms before we dare operate. Hence the big part of the battle is fought before we enter the operating room.

In general the factors which tend to increase the operative risk are: (1) a disturbance of the acid base equilibrium of the body, (2) anhydremia, (3) marked asthenia due principally to malnutrition and anemia, and (4) the presence of infection.

Marked vomiting, when due to pyloric stenosis, causes loss in the vomitus of hydrochloric acid usually in large amount and of base chloride in smaller amount. The loss from the body of the chloride ion is almost invariably compensated for in a large part by retention of the bicarbonate ion in the blood and tissues leading to alkalosis of varying events. Such a shift to and the alkaline side is just as serious as a common urate shift to the acid side (acidosis) if not more so. Death may occur promptly as a result of collapse, cessation of respiration or generalized convulsion with larval spasms. A definite loss of acid by vomiting, alkalosis may be increased by any measure which would tend to cause evaporation of breath. Such instances are commonly seen as a result of crying because of hunger, pain or manipulation. It is important then since all of the factors may be present before or during or immediately after operation to restore if possible the acid base balance of the body to its normal equilibrium before reoperation.

The diagnosis of alkalosis can be made both clinically and chemically. In the first place alkalosis of some degree almost invariably accompanies marked vomiting due to some type of obstruction of the gastrointestinal tract. It is the effect always expected in cases of pyloric stenosis especially if breath is shallow, depressed and irregular with frequent long apneic pauses. Further evidence of alkalosis might be noted in the appearance of general hypotonicity, in which evidences of tetany as carpal and pedal spasm positive Chonk sign or general edema of the limbs. The urine characteristically is free from chloride (when acidified gives little or no white precipitate after the addition of silver nitrate) but also contains a little bicarbonate ( $\text{BiHCO}_3$ ) that it is distinctly acid (pH 5.6) in reaction. The latter point is of importance. Ordinarily alkaline urine will rule out the presence of acidosis of any type except that as associated with nephritis but acid urine not only does not rule out alkalosis but is a sign of the type associated with vomiting but its presence cannot ally in support to the diagnosis. Certain diagnosis of alkalosis





Fig 2 Blunt disector used in dividing the hypertrophied pyloric ring

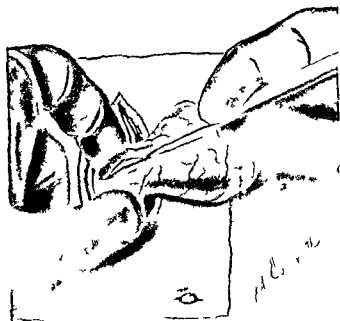


Fig 3 Division of the hypertrophied pylorus with the blunt disector

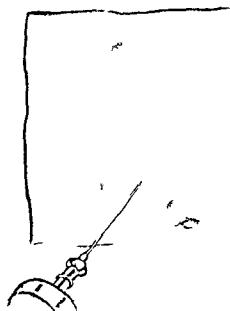
greater curvature of the stomach. This edge of the stomach is drawn into the wound with rubber covered forceps and is followed until the pylorus presents. When the olive shaped hard hypertrophied mass is brought into the wound the index finger of the left hand is hooked over its upper surface and the pylorus drawn well out and held in place by the crooked finger. On the upper anterior face of pylorus there is a practically avascular area which we select for the incision. The incision is made solely with a blunt dissector which was originally designed as a fine dural elevator although any delicately blunt instrument will do (Fig 2). The peritoneum and the hypertrophied muscle are easily divided with this blunt instrument as normal tissue is with a knife (Fig 3). The blunt instrument is advantageous because it makes injury to the submucosa which is exposed over the whole area beneath the muscle incision practically impossible. The divided ends of the muscle are spread apart the submucosa that has been confined by the constricting bundle pouts out and the relief of the stenosis is plainly shown. Another advantage of the blunt dissection is that it is almost impossible in this way to divide the muscle of the normal duodenum and stomach. If by any chance this unhypertrophied muscle is cut



Fig 4 Showing closure of the peritoneum

bleeding results and a ligature may be required. However if no damage is done to normal muscle there is almost never any bleeding.

The pylorus is now dropped into the peritoneal cavity and the peritoneum of the abdominal wall is closed with fine catgut. A small spoon is used as a spatula beneath the line of suture (Fig 4). As the last stitch is about to be tied we insert a tapered glass tube and through this introduce as much warm salt solution as the peritoneal cavity will hold. When about 100 to 150 cubic centimeters have been introduced the solution begins to flow back around the sutures. The tube is then removed and the last stitch tied. The wound is sutured with catgut for muscle and fascia but we bury 3 to 5 fine silk sutures that include the muscle and fascia. We use these non absorbable sutures because under any circumstances healing is poor in undernourished infants and we have seen wounds that were sutured with catgut alone break down throughout. The skin is closed with a silk stitch that includes only the epidermal tissues which in about 9 or 10 days is entirely loose and we are spared the task of taking interrupted skin stitches out of a squirming youngster. To complete the operation a small pad of dry gauze is placed over the wound and held in place by



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y t h f l g I n t h y b t h d f t h e d  
d y t h e f t l l a l e l l t t k e h f l f  
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The operation is done on an improvised hot water table and the baby's arms, chest and legs are wrapped in cotton wool or flannels to protect against chilling. The skin of the abdomen is prepared with alcohol.

Our choice of anaesthetics is 25 per cent novocain in normal salt solution. We use about 60 cubic centimeters over the upper right rectus muscle and in the muscle sheath. The injection is so done as to raise a large tense lump under the skin (Fig. 1). An interval of from 10 to 15 minutes after injection permits considerable absorption of the fluid injected. The incision is then made through the cedematous tissues the peritoneum being anaesthetized by the forceful injection of fluid beneath the rectus sheath. No general anaesthetic is used except that in about 1 out of 10 cases a few whiffs of ether are needed when the wound is being closed.

The incision about 1 inches long over the outer border of the rectus exposes the lower edge of the liver which is held aside to expose the

## IMPROVEMENTS IN PERINEAL PROSTATECTOMY PERMITTING PRIMARY WOUND CLOSURE AND HEALING WITHOUT DRAINAGE

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As late as 1887 Sir Henry Thompson stated that successful prostatectomy was unknown. At that time in his *Treatise on the Diseases of the Prostate* which is still a classic of great value he said: "I desire extremely to see such a result. I have on four occasions removed considerable portions of the prostate but without success. I have traveled considerable distances abroad expressly to see it but without success."

The first man to make a success of prostatectomy was Goodfellow of San Francisco (4) in 1891. His operations were performed by the perineal route. Although sporadic instances of earlier perineal prostatectomies exist they were as a rule partial and merely incidental to the operation of perineal lithotomy or cutting for stone. Goodfellow's technique consisted in placing the patient in the ordinary lithotomy position cutting down through a median incision (Fig. 1B) onto a lithotomy staff in the urethra slipping a finger through the prostatic urethra into the bladder and enucleating the gland. Although a blind operation it required but 5 to 10 minutes for its execution. In 1904 he reported 73 cases with 2 deaths. He apparently was not troubled with postoperative hemorrhage and used no measures to check bleeding at the time of operation.

About 1900 Proust (8) and Albarran evolved a perineal technique paralleling in some respects the Young technique but differing in essential features and today the Proust operation has been entirely abandoned. The operation of perineal prostatectomy which is most widely practiced today had its inception with Young in 1903 (10). What favor the operation now enjoys in the United States is due entirely to the work of Young who has brought it to a high state of perfection. Its main advantages over the old Goodfellow procedure are that the operative field is at all times under direct vision and the possibility of injuring important structures such as the internal and external vesical sphincters is obviated.

The credit for the first complete suprapubic prostatectomy belongs to Eugene Fuller (6 and 12) of New York and was done in 1894. His work was preceded by that of von Dittel in 1885 (9), Belfield in 1886 (1), and McGill (7) in 1887

but these earlier operations were for the most part incomplete removals of the hypertrophic portions of the prostate. Freyer (3) of London who began his work in 1901 probably did more than anyone else to popularize suprapubic prostatectomy and claimed priority for doing a *complete prostatectomy*.

Today we are interested in doing not a complete prostatectomy but a complete adenectomy, shelling out completely the hypertrophic portions of the gland from its false capsule of compressed glandular tissue. The term *complete prostatectomy* is now used only in reference to the radical operation of Young (11) for carcinoma of the prostate.

Twenty years ago the mortality in prostatectomy was 50 per cent or more. Today in the hands of the trained urologist it is 5 per cent or less. This is a remarkable fact when one considers the unusually poor risks that are encountered in the senile sufferers with prostatic hypertrophy. In the hands of the general surgeon and general practitioner the mortality of prostatectomy is still in the neighborhood of 20 per cent. This is due to the fact that many of them are not familiar with and do not recognize the importance of proper pre-operative and post-operative treatment in these cases and further more they do not learn to differentiate accurately the various types of prostatism which can be done only with the aid of the cystoscope. It is essential that the type of prostatism be accurately determined so that the proper treatment may be instituted for the particular type of obstruction encountered. For example in contracture of the vesical neck or median bar formation the treatment is entirely different from that for prostatic hypertrophy yet the symptoms are identical. Hunt of the Mayo Clinic has shown rather conclusively that no matter how excellent a given risk may be the patient should have at least 10 days preparatory treatment in the hospital prior to operation. Poor risks may require much longer. It has been truly said: "The removal of the obstructing prostate is but a mere incident in the treatment of prostatic hypertrophy. Until the general surgeon recognizes these facts patients with bladder neck obstructions will continue to be much safer in the hands of the urologist."

means of small adhesive plaster strips and a narrow binder.

During the operation the baby has a holeless nipple in its mouth as a pacifier and in over half of the cases does not cry at all. In most instances the operation takes only a few minutes and the child leaves the table looking as well if not better than before operation.

The infant is returned to the ward in its cotton wrappings and in 1 hour is given a few sips of water. Two hours later it receives small feedings which are gradually increased and already in 12 hours. In a few days the full sized feedings are given and the infant begins to gain weight. In these cases with but little stomach irritability vomiting ceases after operation provided one does not increase the size of the feedings too rapidly.

In long standing cases in which the stomach has been considerably dilated there may be a little putting up for a few days until the stomach regains its proper tone. The baby is kept in the hospital only as long as it is necessary to get the picture of improvement. The infants in better condition gain much before the end of a

week but the poorly nourished ones may have to remain two weeks.

We have operated upon 81 cases in the first 29 cases there were 8 deaths in the last 52 cases there have been 2 deaths 1 of the latter death being due to a pneumococcus peritonitis the other being due to a peritonitis which started from a small puncture wound of the intestine made by a needle when the wound was being closed. The deaths in the first 29 cases would probably have been much fewer had we understood the necessity of proper preliminary preparation but most of these fatal cases had been treated as emergencies and the necessary adjuncts deferred until after operation. Of the 8 deaths 2 were due to gastroenteritis 1 to pneumonia and 1 to otitis media the others were not definitely explained except as due to inanition.

Bowlin and Downes report results in 434 cases with a total mortality of 15 per cent but in the last 120 cases a mortality of only 8.5 per cent. Mixer in 105 cases had a mortality of 9.5 per cent. Straub reports a mortality of 3.2 per cent which he attributes to careful preparation with transfusion and glucose.

## IMPROVEMENTS IN PERINEAL PROSTATECTOMY PERMITTING PRIMARY WOUND CLOSURE AND HEALING WITHOUT DRAINAGE

By THOMAS F. GIBSON, M.D., SAN FRANCISCO, CALIFORNIA

AS late as 1881, Sir Henry Thompson stated that successful prostatectomy was unknown. At that time in his *Treatise on the Diseases of the Prostate* which is still a classic of great value he said: "I desire extremely to see such a result. I have on four occasions removed considerable portions of the prostate but without success. I have traveled considerable distances abroad expressly to see it but without success."

The first man to make a success of prostatectomy was Goodfellow of San Francisco (4) in 1891. His operations were performed by the perineal route. Although sporadic instances of earlier perineal prostatectomies exist they were as a rule partial and merely incidental to the operation of perineal lithotomy or cutting for stone. Goodfellow's technique consisted in placing the patient in the ordinary lithotomy position, cutting down through a median incision (Fig. 1B) onto a lithotomy staff in the urethra, slipping a finger through the prostatic urethra into the bladder and enucleating the gland. Although a blind operation it required but 5 to 10 minutes for its execution. In 1904 he reported 13 cases with 2 deaths. He apparently was not troubled with postoperative hemorrhage and used no measures to check bleeding at the time of operation.

About 1900 Proust (8) and Albarran evolved a perineal technique paralleling in some respects the Young technique but differing in essential features, and today the Proust operation has been entirely abandoned. The operation of perineal prostatectomy which is most widely practiced today had its inception with Young in 1903 (10). What favor the operation now enjoys in the United States is due entirely to the work of Young who has brought it to a high state of perfection. Its main advantages over the old Goodfellow procedure are that the operative field is at all times under direct vision and the possibility of injuring important structures such as the internal and external vesical sphincters is obviated.

The credit for the first complete suprapubic prostatectomy belongs to Eugene Fuller (6 and 12) of New York and was done in 1894. His work was preceded by that of von Dittel in 1885 (9), Belfield in 1886 (11) and McGill (7) in 1887

but these earlier operations were for the most part incomplete removals of the hypertrophic portions of the prostate. Ireyer (3) of London who began his work in 1901 probably did more than anyone else to popularize suprapubic prostatectomy and claimed priority for doing a complete prostatectomy.

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Twenty years ago the mortality in prostatectomy was 20 per cent or more. Today in the hands of the trained urologist it is 5 per cent or less. This is a remarkable fact when one considers the unusually poor risks that are encountered in the senile sufferers with prostatic hypertrophy. In the hands of the general surgeon and general practitioner the mortality of prostatectomy is still in the neighborhood of 20 per cent. This is due to the fact that many of them are not familiar with and do not recognize the importance of proper preoperative and postoperative treatment in these cases and further more they do not learn to differentiate accurately the various types of prostatism which can be done only with the aid of the cystoscope. It is essential that the type of prostatism be accurately determined so that the proper treatment may be instituted for the particular type of obstruction encountered. For example in contracture of the vesical neck or median bar formation the treatment is entirely different from that for prostatic hypertrophy yet the symptoms are identical. Hunt of the Mayo Clinic has shown rather conclusively that no matter how excellent a given risk may be the patient should have at least 10 days preparatory treatment in the hospital prior to operation. Poor risks may require much longer. It has been truly said: "The removal of the obstructing prostate is but a mere incident in the treatment of prostatic hypertrophy." Until the general surgeon recognizes these facts patients with bladder neck obstructions will continue to be much safer in the hands of the urologist.

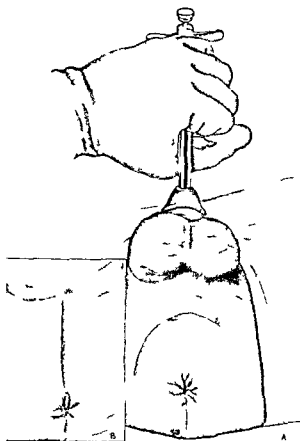
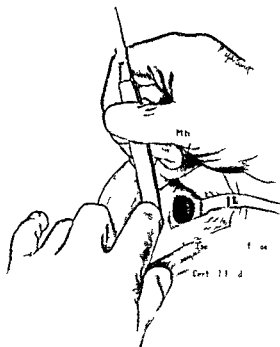


Fig. 111. t t g h t p e f sed p e l  
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Both the suprapubic and perineal operations of prostatectomy have become fairly well standardized yet they share one fault in common and that is our present crude methods of dealing with bleeding at the time of operation. Gouze packing is commonly used to obviate the danger of hemorrhage and also listensible rubber bags but they both offer the same objections (1) they stretch open still further the dilated prostatic cavity which under ideal conditions should be permitted to collapse and shrink as soon as the gland is removed (2) they cause the patient discomfort not only by their presence but by their removal as well and (3) they delay wound healing by leaving behind them a temporary urinary fistula on their withdrawal which requires ordinarily from 2 to 4 weeks to close and in some instances even longer. Packing is not an ideal way of controlling hemorrhage in any operation



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and least of all in prostatectomy where urinary drainage acts as a deterrent to wound healing. In general surgical operations packing is always a last resort when other method fail to control hemorrhage and so it should be in prostatectomy also. Consequently it is desired to present here certain slight modifications in the technique of perineal prostatectomy which render it not only simpler and more foolproof but which also permit primary closure and healing of wounds by avoiding the use of packs or bags and thereby materially shorten convalescence and hospitalization.

Prior to operation blood grouping and coagulation time are determined routinely. Certain prophylactic measures designed to minimize the likelihood of postoperative hemorrhage have been recommended but are perhaps of debatable value. It has been suggested that for 3 days prior to operation the patient be given a cup of jello twice daily and 60 grains of calcium lactate 3 times daily by mouth. Parathormone (Lilly) 15 units may be given subcutaneously twice on the

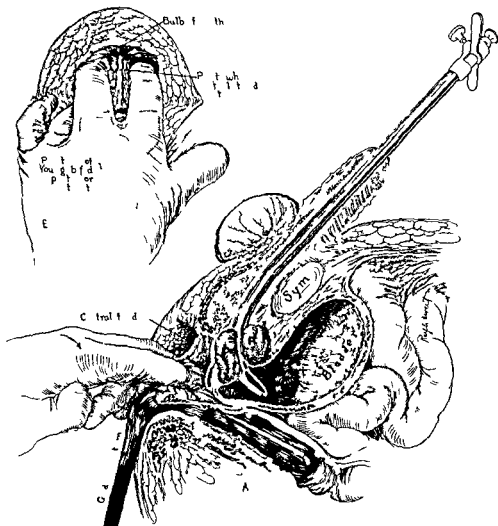


Fig. 3. The third step in the operation is the division of the central tendon below the bulb and transverse muscles. During this procedure the rectum is retracted posteriorly with either the Young bulb retractor or two fingers of the left hand. This is a lateral view of the perineal structures and their relations. The central tendon has been placed under tension preparatory to its division. Note the Crowell tractor passing through the urethra into the bladder with its blades opened and forcing the prostate down toward the wound, the symphysis pubis acting as a fulcrum. Note also the instrument in the rectum serving as a constant guide to its location.

day before operation. The recent work (5) of Gordon and Cantarow points to parathyroid extract as having a possible value in hæmorrhage control. If it is deemed advisable, fibrogen may also be given subcutaneously and calcium intravenously. These measures may be repeated again an hour or two before operation. Anaphylaxis from the use of these things must be guarded against and is not without danger.

Following operation, no matter what means are used to control hæmorrhage, one occasionally meets with a case that will give rise to apprehension. Then it is essential with an adequate syringe to keep the bladder and retention catheter free from clots to repeat the measures above outlined and in addition to try injections of ephedrine

or pituitrin subcutaneously. Sodium citrate given intravenously is said to shorten coagulation time. Plenty of fluids by hypodermoclysis and rest obtained by morphine are essential if there is post-operative bleeding. The bladder may be flushed with a warm solution of potassium permanganate 1:4000 and if necessary an instillation of 10 per cent antipyrin solution may be given. Irrigating the bladder with a 2 per cent alum solution followed immediately by an instillation of 1 ounce of 50 per cent aluminum acetate mixture which is retained often serves a useful purpose. The perineum is tightly compressed with a double spica bandage, a roll or two of rolled bandage being placed against the perineum to exert additional pressure. Intramuscular injections of





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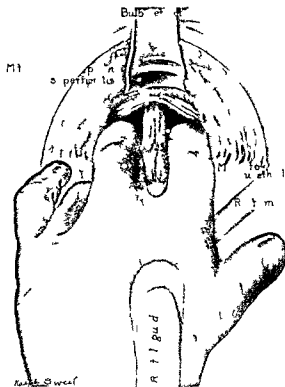
while blood seum occasionally to be useful. It may in rare instances be necessary to re-pen and pack the wound and as a last resort to give a blood transfusion.

On the morning of operation before the patient leaves his room the urethra and bladder are thoroughly irrigated with a 4 per cent solution of boric acid followed by the instillation of 1 ounce of 5 per cent arviol. Gas and oxygen anaesthesia is given those patients who do not wish to be present at their operation otherwise spinal anaesthesia is used in most cases. For spinal anaesthesia cubic centimeters of a 5 per cent solution of alioaine (Lumiere) with the addition of adrenalin is used.

The next step of importance in perineal prostatectomy is the position of the patient. The ordinary lithotomy position with feet in stirrups is usually used by the gynecologist for vaginal retraction is entirely adequate for an excellent exposure of the prostate. The operator can sit and work at ease. The buttocks must project slightly beyond the end of the table so as not to interfere with the retractors. The perineal board and other special apparatus designed to improve the exposure of the prostate I regard as totally unnecessary encumbrances which only add to the complexity of the operation and the discomfort of the patient. The perineal board was originally devised by Halstead for rectal work and adopted by Young for perineal prostatectomy. It served a useful purpose in the developmental phases of their work but now in the light of more definite anatomical knowledge and established surgical procedure it is not essential. The hips can be flexed just as completely with the patient lying in a comfortable horizontal position as by standing him virtually on his heels on the perineal board. I can see no advantage in any type of perineal elevator. Even sandbags are unnecessary.

The technique followed in the operation is essentially that of Young with minor changes which will be described. The accompanying reproductions of drawings of an actual operation render superfluous detailed description. Figure 1 and 3 illustrate the primary incision with the Crowell tractor in place, the penetration of the ischio-rectal fossa on either side of the central tendon and the division of the latter structure.

We now approach the crucial part of the operation which is the Waterloof of the novice. It must be constantly borne in mind that the rectum is always in close proximity throughout the exposure of the prostate and that it is held anteriorly against the posterior surface of the gland by the recto-urethral muscle. This muscle is not a distinct entity but represents merely the attachment of a portion of the longitudinal



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muscle fibers of the rectum to the region of the apex of the prostate so that at this point there is no definite line of demarcation between rectum and prostate. To facilitate the exposure of the prostate at this stage without danger of injuring the rectum a rectal guide (Fig 4) has been devised. For an expert perineal surgeon it may often be superfluous, yet it may prove very comforting at times. With the urethral tractor on one side and the rectal guide on the other (Fig 5A) the surgeon is guided unerringly to his destination just as a ferry boat is guided into its slip by the bulkheads on either side. Thus having one's bearings it is easy to make a small midline slit through the rectourethralis near its attachment to the apex of the prostate (Fig 5) grasp each side of the opening with Allis forceps and slip a knife handle down over the posterior surface of the prostate between the layers of Denonvilliers fascia (Fig 6). This opening is enlarged enough

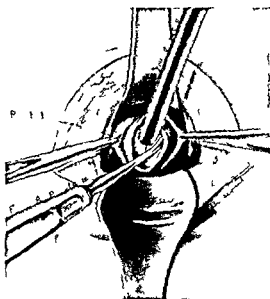


Fig 7 A midline incision made in the prostate onto the instrument in the urethra. This incision is extended to the base of the prostate and does not approach too closely the apex where the external vesical sphincter lies. The plane of cleavage between capsule and prostate is now reached and enucleation is begun with the Kocher's sector. If the cord is exposed, the Crowell tractor is removed and replaced by the short Young prostatic tractor which passes through the wound into the bladder and its blades opened so as to aid in the enucleation by pulling the prostate into the wound.

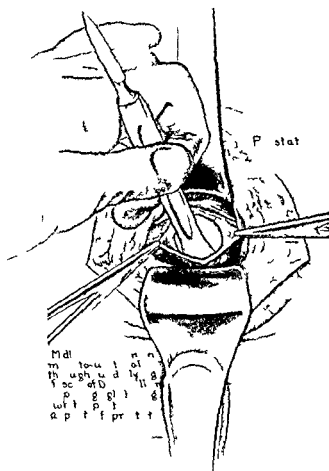
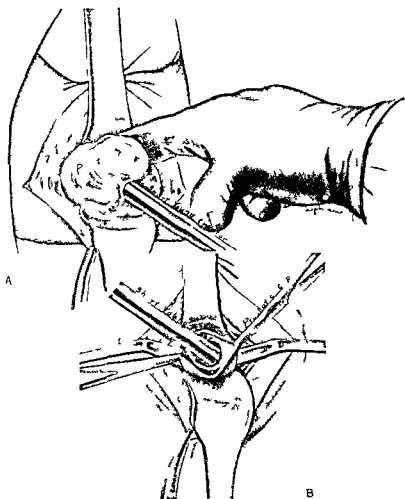


Fig 6 The margin of the midline slit in the rectourethralis is grasped with an Allis forceps and a knife handle slipped down over the posterior surface of the prostate between the layers of Denonvilliers fascia which covers the posterior aspect of the prostate gland. The smooth gleaming gray white surface of the prostate is now visible.

to permit a midline incision through the prostate on to the instrument in the urethra (Fig 7). This incision is between the ejaculatory ducts and apparently does no harm either to the ejaculatory ducts or to the verumontanum. Following prostatectomy cystoscopic inspection of the posterior urethra in two cases has shown a normal looking verumontanum and sexual potency has been preserved in a fair percentage of cases. As a matter of fact injury to the verumontanum is probably of little consequence and I recall one instance in which the verumontanum was accidentally removed with the prostate without loss of the sexual powers.

As has been shown the operation following the cutting of the central tendon has been confined strictly to the midline and thus the nerves and blood vessels which course laterally are avoided. The enucleation of the prostate is accomplished as shown in Figures 7 and 8A. Since the whole field is under direct vision there is practically no danger of leaving hypertrophic remnants which might lead to recurrence.

With the prostate removed we now have the condition shown in Figure 8B. A smooth round snug internal sphincter is usually left following the enucleation. It is beneath the edges of the mucosal flap that the chief bleeding is apt to



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cur In the past it has been the custom of the surgeon in his inordinate hurry to complete the operation to insert gauze packing immediately after the enucleation and to close the wound without any special effort to ascertain the nature of the bleeding. Probably most prostatectomy patients would cease bleeding if nothing were done but it is not safe to leave nature to its own devices. Why not take 5 minutes at this stage of the operation to stop any bleeding and if possible to avoid the use of packs or bags? The bleeding surface is under direct vision in the perineal operation and can be thoroughly inspected with the aid of a speculum, a Cameron light or some other means of illumination. Spurters and bleeding points can be readily caught with a hæmostat and ligated. Occasionally a suture in the flap of

vesical mucosa will check hæmorrhage. A mattress suture of the posterior lip of vesical mucosa to the prostatic capsule is sometimes used with good effect because it is there that the most troublesome bleeding usually occurs. The Young boomerang needle is useful for this maneuver. For general oozing stick sponges saturated with hot sterile Monsell's solution of 10 per cent strength applied to the oozing surface are extremely satisfactory. This solution has been used at the suggestion of Dr Henry Meyer of San Francisco who has used it for 15 years in suprapubic prostatectomy with good results and without causing any apparent injury to the tissues or delay of wound healing.

A m f f d r h m f t l t f d i  
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Once careful inspection shows that all bleeding has ceased it is then safe to dispense with packing or bags. The wound is closed as illustrated in Figures 9, 10 and 11.

After returning to bed the patient is routinely given 1000 to 2000 cubic centimeters by hypodermoclysis and the urethral catheter is connected with a Connell suction apparatus in order to keep the bladder drained dry and to keep urine off the healing wound. The Davis bottle, Chapman filter pump or any other type of suction apparatus which does this satisfactorily may be used.

Abstracts of 4 representative cases are appended. Cases 1 and 2 show what may occasionally be accomplished by the old method of routine packing and drainage. In Cases 3 and 4 the wounds were closed without packing or drainage according to the technique which has been described.

CASE 1. C. P., 69 years of age, had a moderate sized glandular type of hypertrophy removed by the perineal route. Spinal anesthesia (alocain) was used. At the close of the operation a 28 I. catheter was passed to the bladder through the urethra and a 28 I. tube rough the wound to the bladder. The prostatic fossa was packed with 2 inch gauze strips and the wound closed as shown in Figures 9 and 10.

After the patient was taken to his room a Connell suction was started. The gauze pack and perineal catheter were removed in 48 hours. The patient sat up on the fifth day and began walking on the seventh day. The urethral catheter was removed on the ninth day. There was no leakage through the perineum at any time following operation in spite of the fact that the wound had been disturbed by the presence of the packing and the perineal tube. The patient was discharged from the hospital on the fifteenth day after operation in excellent general condition. The wound had healed solidly without any reaction and there was good functional control of urination.

CASE 2. R. M., 72 years old, had a small adenomatous glandular type of hypertrophic prostate removed under spinal anesthesia (neocain). Urethral and perineal catheters to either side of the wound were used. In Case 2, Connell suction was used continuously to keep the bladder dry following operation. The perineal catheter and packing were removed in 4 hours. The urethral catheter was removed on the seventh day after operation and the patient began to get up. At no time was there any leakage of urine through the perineum. However a mild attack of epididymitis without fever occurred. The patient was not allowed to leave the hospital until the twelfth day and lay after operation.

CASE 3. C. B., 63 years old, had a perineal prostatectomy performed under spinal anesthesia (tropicain). The large sized glandular type of hypertrophic prostate shell out completely almost no bleeding. The incision was closed without packing or drainage, any sort as shown in Figure 10b. A 28 I. catheter was placed in the urethra and the bladder kept dry with continuous Connell suction. The catheter was removed on the tenth day. The wound healed perfectly without the slightest sign of reaction or drainage and the patient left the hospital on the fourteenth day in excellent general condition and with good control of urination.

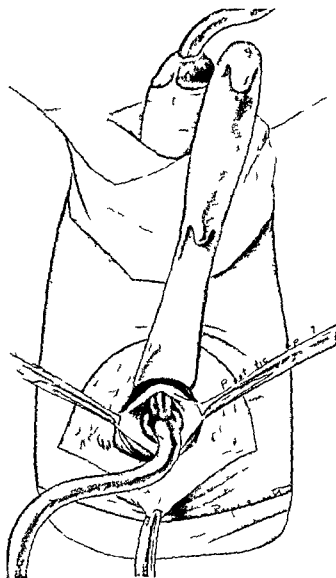
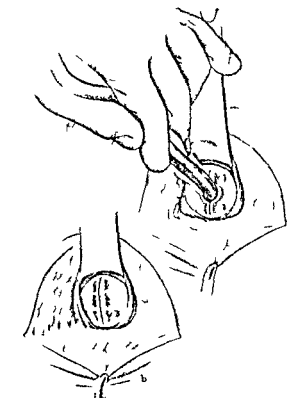


FIG. 9. Drainage is provided via the natural channel by means of a 28 I. catheter passed through the urethra into the bladder. A second catheter through the wound to the bladder is used only in the cases in which it is necessary to resort to packing to control hemorrhage.

CASE 4. O. I., 66 years old, had large glandular type of prostate removed perineally under spinal anesthesia (alocain). The wound was closed without packing or drainage as shown in Figure 10b. A retention catheter was placed through the urethra to the bladder at operation and Connell suction was constantly maintained until the twelfth day after operation and the patient got up out of bed. The wound healed perfectly without the slightest redness or reaction of any kind and the patient was discharged from the hospital on the twelfth day after operation in good condition and with good control of urination.

If packing is used it is only in rare cases that primary healing without urinary drainage occurs as in Cases 1 and 2. In general, 2 to 4 weeks are required for a urinary fistula to heal. All of the cases in which bleeding has been controlled without resorting to packing and in which the wound has been tightly closed without the institution

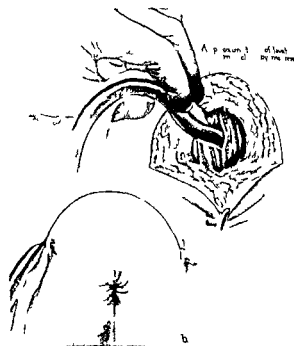


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f drainage as in Cases 3 and 4 have healed *per primam* without subsequent breaking down. All of the cases reported have had infected urine follow up records in these 4 cases have shown in excellent ultimate result. Closure of urinary wound without drainage contrary to one of the oldest axioms of surgery yet in these cases we have an outlet for drainage through the natural channel and experience has now shown that this can be safely done in many cases without jeopardy to the patient at the same time shortening his stay in the hospital saving dressings and adding to his comfort while there. Perineal prostatectomy ordinarily requires 30 to 45 minutes actual operating time. Why not spend in extra 5 minutes in the systematic control of bleeding if it will save the patient weeks or more in the hospital?

#### SUMMARY

1 Prostatectomy is still a relatively recent development in the field of surgery having first



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been successfully performed by Goodfellow who began to do perineal prostatectomies in 1891. Suprapubic prostatectomy has an even more recent origin as the first successful operation of this type was performed by Fuller in 1894 and popularized by Freyer in 1901.

The great reduction in mortality rate which characterizes prostatectomy in the hands of the trained urologist today has been achieved as a result of more accurate differential diagnosis and fuller realization by the surgeon of the importance of thorough preoperative and postoperative treatment bearing in mind that the operation itself is but a mere incident in the treatment of prostatic hypertrophy.

3 In spite of its present high plane of achievement prostatectomy both suprapubic and perineal is subject to certain defects chief among which are our present crude method of controlling bleeding by the use of packs and bags of various sorts. Such subterfuges are resorted to only as a court of last resort in other surgical operations and this should be particularly true in

prostatectomy in which they delay wound healing and encourage the prolongation of urinary drainage.

4 Modifications in the technique of perineal prostatectomy together with methods of dealing with bleeding are outlined which should in a high percentage of cases permit primary wound closure and healing without urinary drainage and thus add materially to the brevity and comfort of the patient's stay in the hospital. The technique employed is essentially that of Young except that the patient is placed in the ordinary lithotomy position, a special instrument is inserted into the rectum to guard against injury to that structure, a midline incision is made in the prostate which permits easy closure following enucleation, under careful visualization bleeding is entirely checked by suture and sponging with warm 10 per cent Monsell's solution and the wound is closed tightly in layers with mattress sutures of No. 2 chromicized gut without drainage. All drainage is taken care of by an adequate suction apparatus attached to a retention catheter in the urethra.

5 Four illustrative cases of perineal prostatectomy are reported in which healing occurred *per primam* without urinary drainage through the wound at any time. Three of them were discharged from the hospital 2 weeks after operation in excellent condition. The fourth patient was not allowed to leave the hospital until 3 weeks after operation owing to the occurrence of a mild attack of epididymitis.

It is hoped that this contribution will mark a new epoch in prostatectomy which will bring it a step closer to the goal of an ideal operation.

#### BIBLIOGRAPHY

1. BELLFIELD W. T. Prostatic myoma removed by suprapubic prostatectomy. *J Am M Ass* 1897 viii 303.
2. DEWEY J. B. Enlargement of the Prostate. Philadelphia: P. Blakeston's Son & Co. 1922.
3. FRYER P. J. Total extirpation of the prostate for radical cure of enlargement of the organ. *Brit M J* 1901 ii 15 190 ii 45.
4. GOODFELLOW G. Median perineal prostatectomy. *J Am M Ass* 1904 xliii 194.
5. GORDON and CANTAROW. The use of parathyroid extract in hæmorrhage. *J Am M Ass* 1907 lxxviii 1301.
6. GUILLERAS R. *Urology*. New York: D. Appleton & Co. 1912 ii 91-295.
7. McILL A. T. On suprapubic prostatectomy with three cases in which the operation was successfully performed for chronic prostatic hypertrophy. *J Clin Soc Lond* 1888 xi 52.
8. PROUST. *Manuel de la Prostatectomie Perineale pour Hypertrophie*. Paris 1903.
9. VON DITTEL. Blasenpunction und nachtragliche resection des mittleren lappens wegen hochgradig hypertrophie der prostata. *Wien med Bl* 1898 viii 20 301.
10. YOUNG H. H. Conservative perineal prostatectomy, a presentation of new instruments and technique. *J Am M Ass* 1903 xli 999-1009.
11. Idem. The early diagnosis and radical cure of carcinoma of the prostate: a study of 50 cases and presentation of a radical operation. *J Am M Ass* 1906 li.
12. Ilem. *History of the Technique of Prostatectomy*. Keen's Surgery. Philadelphia: W. B. Saunders Co. 1908 iv 432-439.

# INCONTINENCE ELIMINATED BY CÆSARIAN SECTION AND URETHRAL TRANSPLANTATION INTO THE SIGMOID

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THROUGH the increasing success in the transplantation of the ureters into the sigmoid with the adoption of the general principles put forward by Coffey, there is rapidly appearing a relatively large group of patients who react to pregnancy operation and who have not been frequently observed. We feel therefore that any contribution we might add at this time may be of value.

Until recently bilateral ureteral transplantation had been done chiefly for the relief of congenital fistulæ while it is commonly improper to ureteral vesicovaginal fistula, cancer of the bladder and tuberculosis had been treated by this procedure.

In the University Hospital we have had 6 cases of exstrophy of the bladder, 1 epispadias during the past 10 years which required ureteral transplantation. Fourteen of the 6 were operated upon while 11 were under 5 years of age and it seemed advisable to postpone operation. One patient, at 10 years of age, and a dangerous risk. It is interesting that 11 patients were females and 14 were males. Statistics from all other sources show that there is a marked predominance of males. In addition to this group of cases with congenital deformities Cabot has transplanted the ureters in the case of cancer of the bladder in two with irreparable damage to the urethral sphincter and in a fourth with intractable bladder pain. Peterson has recently reported two cases of inoperable vesicovaginal fistula treated in this manner. One of us (C. W. E.) transplanted a single ureter successfully for tuberculosis of the kidney and bladder. Of our 11 operative cases 9 were adult females, all of whom might become pregnant. It is this group with which we are here chiefly concerned.

A review of the literature shows that pregnancy in patients with exstrophy is not as uncommon as might be expected. Miller and King discovered 14 reported cases up to 1918. Sage has since added another. There are only three cases of pregnancy reported in patients with transplanted ureters. One of these terminating in the birth of twins was reported by Charles Mayo as a second case reported by Knauf of the Mayo Clinic. The third, recently observed by A. B. Green, Armynt, He successfully delivered a normal

child by cesarean section in a patient who had had ureteral transplantation done 14 years before by the Eisters method. We add one case to this group.

In operating on our patient we observed the principles set down by Coffey for successful transplantation of the ureters. Though Coffey, C. H. Mayo and Lower prefer the intrajulvic approach we feel that the extraperitoneal method is simpler and gives equally good results. The danger of infection which Lower emphasizes in practice is not great. Nineteen of our cases were done by this method during the past 10 years with no serious infection. There was one operative death from unexplained rectal hemorrhage in a patient of 51 years.

We use the following technique as a rule. The ureter is approached through an oblique split muscle incision, the right side always being done first. As the peritoneum is stripped from the pelvic wall the ureter will be carried with it. It is picked up at the bifurcation of the iliacs and mobilized to within a centimeter or two from the bladder, then cut across as low down as possible. The distal stump is tied. A 5 centimeter peritoneal incision is begun at the point opposite the fixed portion of the ureter. This will prevent kinking over the edge of the peritoneum. A loop of sigmoid is drawn through the peritoneal opening and a 3 centimeter incision is made through the longitudinal muscular band to the mucosa. The mucosa is then easily stripped back 1 centimeter on each side and a bed is prepared for the ureter. The preparation of the end of the ureter and its implantation into the bowel proceed as described frequently by Coffey and C. H. Mayo. In the closure of the musculature over the ureter we modify the technique slightly. It is impossible to compress the ureter against its mucosal bed by rolling in too much of the wall of the bowel in an effort to seal the wound. At the point where the ureter enters the muscular at the proximal end of the wound, however, it may easily be shut off by drawing the full thickness of the intestinal wall over it. Coffey's tubes temporarily avoid this as does the strand of catgut used by C. H. Mayo. It may also be avoided if the closure of the musculature is discontinued just at the point where the ureter enters it.

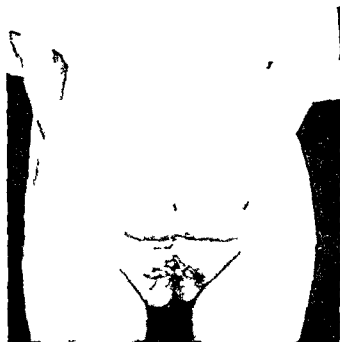


Fig. 1. The abdominal and external genitalia of a patient who had the ureter transplanted into the sigmoid 4 years before.

Since a leak here is possible though rare if a rectal tube is kept in the bowel for a few days after operation we allow about a centimeter of the bowel to remain exposed extraperitoneally and seal it off by suturing the peritoneum to the intestinal wall at one or two points. This also serves to fix the bowel and prevent pull on the ureter. The rest of the bowel is returned to the peritoneal cavity and the peritoneum is closed over it. A small gutter percha drain is left in the wound after it is first carefully washed out. Urine usually appears in the rectum at once. In a week or two the patient is ready for the second stage.

After an operation of this type our patient was promptly restored to society and within two years we were faced with the problem of marriage and later pregnancy. There were two important sources of danger. One the deformity of the pelvis the other renal damage due to the increased load under abnormal conditions. Williams says of split pelvis: "Owing to the descent of the promontory of the sacrum and the absence of union at the symphysis there is marked transverse widening of the posterior portion of the pelvis while the anterior portions extend more or less parallel. He also observes that for practical purposes the pelvis may be considered as generally enlarged the dystocia being due to abnormalities of mechanism resulting from the abdo-



Fig. 2. Same patient as in Figure 1 showing details of external genital deformity.

men of a resistant anterior pelvic wall. Jelliff agrees that little or no difficulty is experienced during labor in consequence of the absence of any resistant force. Miller and King however found among their 14 cases recovered from the literature only four with fairly easy deliveries.

A brief report of our case follows.

Four years ago Miss J. S. (120335) aged 19 years was admitted to the University Hospital for treatment of ectropion of the bladder. Bilateral transplantation was done by one of us (C.W.E.) in two stages as described. The patient recovered without difficulty and married and in August 1927 she reentered the University Hospital pregnant at term. The abdomen showed the normal distention of a full term pregnancy. The umbilicus not prominent. A firm low midline scar marked the site of the ectropion bladder. The two lateral operative scars through which the transplantation of the ureters had been well healed and showed no signs of hernia. In the midline just below the fibrous symphysis and around with dense scar tissue was the mass which



Fig. 3. X-ray of patient shown in Figures 1 and 2. Note the pelvic deformity.





THE PATHOGENESIS AND THE SURGICAL TREATMENT OF GASTRIC CRISIS OF TABES NEURORAMISECTOMY<sup>1</sup>

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## VISCERAL PAIN

**A** CONCEPTION of pain the most human of sensations is the least well established. To outline the theories concerning it would require pages therefore we will present only a few elemental points necessary for an understanding of certain attempts in modern surgery.

A preliminary question arises. Are the viscera sensitive? Lenander says that the vegetative fibers do not conduct painful impulses there is pain only if the sensory nerves are irritated through the parietal peritoneum. Mackenzie also believes that the viscera do not have autonomous sensibility but that sensations are projected to the surface. Head believes that the viscera have protopathic spatial diffuse sensibility. Kappis thinks that the peritoneum the omentum the tissues which separate the organs especially that which surround the vessels are sensitive to pain while Bruning, Goldscheider and Breslau believe that visceral pain originates at the level of the organ itself.

That a viscus does not react to a prick, a burn or some other kind of stimulus does not prove that sensations of pain cannot take place in it but simply that the adequate stimulus has not been applied.

A point on which everyone agrees is that in order to provoke a painful sensation one must have an adequate stimulus qualitatively and quantitatively abnormal taking place at the level of the organ itself or of its afferent nerves. At the level of hollow organs like those we are interested in this stimulus is most often distention (Briscoe, F. Meinel, Lutembacher), spasm inflammation (Lemaire) or anæmia (Nothnagel). Distention and spasm are intimately associated according to the law of Bayliss-Starling. All contraction of the intestine is accompanied by a relaxation of the preceding segment.

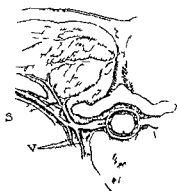
Abdominal irritation manifests itself by two types of pain. One in the organ itself which is more than discomfort and another at the surface of the body which is a true painful sensation. The second type the referred pain—localized most often in the corresponding cutaneous territory or in a more distant segment of the organ in which case the determination of origin is more difficult (Forgue).

The connections of ganglia of the sympathetic chain with the spinal centers explain the reference of pain in the metamere and the displacement undergone by certain metameres during the evolution of the body explains certain paradoxical types of referred pain but not all of them. The visceral excitation expresses itself by pain in the corresponding segment. The surface corresponds to the zone of Head.

MacKenzie has clearly demonstrated the reference of pain to the periphery and his scheme of conduction is well known. This viscerosensitive reflex which is not a reflex in the physiological meaning of the word takes the route of the cord. The English school of physiologists headed by Langley and Gaskell agrees with the clinicians on this point.

The course of the sensory fibers is the same in all sensory nerves that is direct to the cells of the ganglia of the posterior root without synapses in the peripheral ganglia. This touches on the much discussed problem of the central pathway of the sympathetic fibers. MacKenzie, Langley and Gaskell believe that this connection is through the spinal cord the sensory neuron has its cell in the spinal ganglion and is connected with the sensory fibers in the cord through the posterior horn. This conception is the most frequently accepted and seems to be confirmed by the work of Edgeworth, Koelliker and more recently of Kossí, Danielopolu and Lemaire basing their opinion on the morphological data of Ramon y Cajal. Dogiel and Efinger believe that the synapse is located at the T cell of the spinal ganglion. The problem remains undecided but most of the recent investigations seem to confirm the conception of Gaskell (Ruiz Arna).

The recent experiments of Lemaire on the disappearance of certain visceral pains after the sensory neuron of the corresponding metamere has been anesthetized adds support to MacKenzie's idea. The abolition of sensibility in the area of reflection immediately suppresses pain of the viscera. It does not prove that the relay between the sympathetic system and the cerebral nervous system takes place in the spinal ganglion. Admitting that this synapse has been demonstrated histologically how could a referred pain be produced by direct irritation even if the impulse travels in a direction opposite to the



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functional polarization of the cell. The experiment of Lemur proves and (this) important that the functional integrity of the conduction system is indispensable in the experiment of visceral pain.

Although we refer to the mechanism of visceral pain, the functions on the junction suggest a possible conception of the mechanism of visceral pain. A adequate peripheral stimulus reaches the cord put it in a state of activity which serves to provoke exaggerated motor reactions in the organ concerned leading to hyperfunction which rapidly exhausts it. Soon the muscle of this organ ceases to be excitable the viscus becomes distended and the distention constitutes an obstacle to the passage of the impulses. The block of the impulses overloads the afferent sympathetic system and results in stimulation of the corresponding spinal segment expressed as a contracture and pain in the respective muscles. The prolonged excitation of the spinal segment leaves behind it a state of local hyperexcitability.

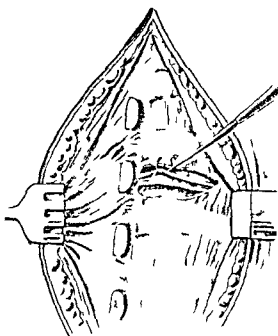
This abbreviated sketch permits a better understanding of the mechanism of gastric pain.

#### GASTRIC PAIN

Pain originating in the peritoneal peritoneum is transmitted by the intercostal and phrenic nerves. Pain of the visceral peritoneum is transmitted by the major splanchnic nerve except when it is in the descending colon and the sigmoid when it is carried by the minor splanchnic nerve. The painful sensations of the stomach pass over the vagus (Max Kappis and Shauwer).

Operations to relieve gastric pain have necessarily been influenced by the prevailing ideas

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concerning the conduction of visceral pain that is the possible site for operations to relieve pain range from the peripheral neuron up to the central nervous system.

To relieve visceral pain, Lemur treated the sensory endings medicinally. Jaboulay attacked the peripheral ganglia with varied results. Danielescu directed his efforts to the radical segment. Sicard and von Czerny soon abandoned their efforts to obtain results by operation on the spinal ganglia. Von Czerny and Leriche depended entirely on operations on the rami communicantes. Frazier, Souttar, Iversen, Sicard de Martel and Poincaré are all attempting to relieve pain by severing pathways in the spinal cord. This migration from the periphery toward the centers marks the actual evolution of surgery of pain.

#### THE SYMPTOMS OF GASTRIC CRISIS OF TABES

Notwithstanding the frequency of tabes a serious clinical study of gastric pain in the disease offers interesting facts. One of us (Van Boert) has had the opportunity of following a great number of cases of tabes in a department of syphilology of the Belgian State and of collecting numerous histories.

## PAIN

Clinical observation allows the grouping of the thoracovisceral pains in three categories

*Pain with metameric topography.* The onset of the gastric or intestinal crisis has in a great number of cases of tabes a definite radicular character. Pain starts in the back near the vertebral column it radiates laterally and reaches the epigastric or subumbilical region. There are lightning like pains which follow each other rapidly for a rather short time occasionally for a few hours. The seat of the pain is deep and definitely localized. The pain introduces or ends the true gastric crisis and is the thoracic equivalent of radiculitis of the sciatic type in the lower limb and of the cubital type in the upper limb. Study of sensation shows objective disturbances of a radicular distribution: hypoaesthesia or hyperaesthesia of the metameric area is corresponding to one or several roots.

The following case illustrates this kind of pain

CASE 1. A woman aged 38 years received the initial syphilitic infection in 1908. Shooting pains were first felt in 1918. At this time the patellar and ankle jerks of the upper limbs were abolished. There was great ataxia. Romberg's sign was marked. Radicular pain corresponding to the seventh, eighth, ninth and tenth dorsal segments was present on both sides. Hyperaesthesia to pain and to touch was marked and the patient made mistakes in thermal appreciation. Myosis and anisocoria were present, the right pupil being larger than the left. The pupils reacted to light and to accommodation. Two gastric crises with radicular onset had occurred in 1913 and 1924.

*Sympathetic pain en nappe.* In other cases, on the contrary, pain occurs spontaneously in areas of variable extension and indefinite limits without radicular or neuritic distribution. The pains are continuous, superficial and undergo spontaneous exacerbations; they give the patients sensations of constriction or crushing and resist most of the analgesic measures. These sheets of pain are usually situated in the epigastrium, sometimes at the level of the left hypochondrium, occasionally surrounding the right shoulder and in some cases in smaller patches near the vertebral column.

During the periods of extreme pain the pilomotor reflexes are very acute, the patient screams at the slightest touch. At the level of the pains one may observe distinct red vasomotor lines. In certain cases the injection of pilocarpine increases the pain and in two of our cases provoked sudation over the hyperalgesic area.

Clinically these pains recall the true sympathetic crisis and although we reserve judgment as to whether or not there is a pain belonging specially to the peripheral sympathetic fibres we believe that it is possible that they have their origin in

the irritation of the afferent path of the sympathetic system. The following crises illustrate pain en nappe.

CASE 2. A woman aged 46 years gave no history of hereditary syphilis. She had given birth to ten children six of whom were living and well; there had been three miscarriages. The data of syphilis infection was not known. The present illness began 4 years previously with headache and diffuse pain of a rheumatoid type affecting the superior and inferior limbs. The chief complaint were shooting pains, trouble with hearing, slight dysuria and decrease in vision.

On examination the patient's walk was found to be slightly ataxic and stiff. There was marked tremor of the upper limbs and of the tongue. The tendon reflexes of the upper limbs were well marked on both sides; the patellar and ankle jerks were abolished. At the level of the lower limbs and in the subumbilical region there were disturbances of deep and superficial sensation, especially tactile and thermal. There was a degree of sensitiveness of the bone. Paroxysmal pains en nappe of a sympathetic character occurred in the region of the epigastrium and of the left hypochondrium. Cranial pain was present. There were areas of hyperaesthesia to touch and pain at the level of the sacrum and in an oval above the left breast. The injection of 40 per cent iodized oil showed that there was no obstruction in the spinal canal. Myosis and anisocoria were present, the right pupil being larger than the left and irregular. Reaction to light was abolished on both sides. The Bordet Wassermann test was slightly positive in the blood.

CASE 3. A man aged 40 years had contracted the initial syphilis infection in 1903. The onset of the present illness was characterized by shooting pain in the lower limbs and cervical crisis. For 2 years there had been extremely hyperalgesic plates in the epigastrium, the left hypochondrium and the left flank and pains of the causalgic type in the right shoulder. These pains were not relieved by any analgesic. The patient suffered from crises of the crushing type in the epigastrium. During the crises a red line followed stroking in the region of the epigastrium. The patellar, ankle and mediopubic jerks were abolished. All abdominal cutaneous reflexes, with the exception of the cremasteric, were preserved. The eyes were unaffected. The Bordet Wassermann test in the spinal fluid was positive. Twelve cells and albumin 0.55 were present. The Pandy and Weichbrodt reactions were positive.

Shaw also distinguishes a dull, vague and constrictive pain which does not correspond to the sympathetic pain just described and which does not disappear after posterior radicotomy.

*Deep gastric pain.* Deep gastric pain has been well described and is known to all clinicians. The painful reaction is intimately bound up with sensory motor reactions (nausea, vomiting and gastric hyperkinesia) but pain may exist alone and in that case takes on the aspect of true classical splanchnic crisis.

## DIGESTIVE SYMPTOMS

Nausea and vomiting are the predominant digestive symptoms. The nausea may be extremely

marked and is associated with the following symptoms: dizziness, headache, vertigo, nausea, vomiting, epigastric pain, etc.

troublesome it may occur alone for several hours before the painful crisis or the vomiting itself may constitute the entire gastric crisis the vomitus being finally reduced to bile tinged sputum. In certain cases nausea is associated with migraine hemicrania with throbbing pain in the temporal parietal region intense and dull occipital pain recalling at times that of tumor of the posterior cerebral fossa. One of the patients in whom we operated had been complaining of nausea alone sometimes persisting for 3 or 4 days.

Ordinarily in true gastric crisis vomiting is a prominent symptom it is uncontrollable sometimes spasmodic and coincides most often but not always with a nauseous state. Sometimes one meets with nausea without vomiting and less exceptionally with violent pain not associated with gastric intolerance.

The mechanism of the vomiting is complex in a certain number of cases we have been able to verify on the fluoroscopic screen existence of spasm of the pylorus with intense peristalsis and antiperistalsis so marked as to force the cardiac stomach mechanically. In other cases however there was a flask stomach. The nauseous excitations may be central in origin and indeed it is difficult to admit that increase in abdominal diaphragmatic pressure by valvular irritation may not by itself precipitate the reflex of vomiting. These cases are exceptional and in the majority of instances digestive hyperkinesis is the rule. One frequently observes prolonged spasms of the small intestine and of the right colon and constipation is often noticed.

### HICCUGH

Hiccough is relatively rare in the very painful forms of crisis with vomiting and in the crisis of nausea. A typical case is reported in which the gastric crisis manifested itself only by deep pain in the right hypochondrium a dull ache in the right shoulder and shoulder blade and persistent hiccough during several days resisting all therapeutic measures. The case has been followed for 4 years and not once has there been any vomiting or nausea.

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### NEUROVEGETATIVE TROUBLES

The gastric crisis of tabes is essentially an irritative syndrome of the afferent gastric paths and therefore the two great vegetative arches the sympathetic and the vagus must be considered in dealing with the disorder. There are two great varieties of gastric crisis of tabes sympathetic and agal. We were interested in determining if there is a particular mechanism for each variety and consequently a particular form of treatment.

Does the state of the patient's vegetative system precipitate or influence the course of the visceral crisis? The question is not new. Wurtz and Levy and Harkins have described a sympatheticotonic form of tabes with arthropathy visceral anthesia permanent tachycardia and abolition of the oculo-cardiac reflex. Harkins believed vagotonia was responsible for the larynx spasms abdominal pain paroxysms with sialorrhoea gastrorrhoea and so forth.

We have tried to review this question systematically. One agrees with most of the clinicians at once in considering the vegetative equilibrium of an individual at a certain time as the expression of integrative action of the sympathetic and parasympathetic nervous systems (Danielopolu). The pathological vegetative phenomena result from a series of disturbing factors including (1) a modification of the normal amphitropism of the medium (2) a local lesion of the organs (3) a lesion of the extraviseral or other efferent nervous paths able to influence the vegetative functions and (4) the functional state of the afferent routes.

It is evident that the last three factors play a manifest rôle in tabes. The lesions of the organs strongly influence the local tonus the terminal ganglia the sympathetic or parasympathetic endings and the intervisceral connections. On the other hand lesions of the cortex and of the paths which join the cortex to the vegetative centers modify the reactions of these patients. It is evident that one cannot appreciate the value of each factor separately.

We have chosen three tests two very reliable ones (administration of atropine) the other more complex and less conclusive (intravenous injection of epinephrine).

The courses of four cases have been studied for more than years three of the patients were

amphotonic and one vagotonic. The behavior of the amphotonic patients followed the rule formulated by Danielopolu. In amphotonia the hyper-tony predominates upon the excitors whether they are represented by the sympathetic (heart) or by the parasympathetic (digestive tract). In two of these cases studied during gastric crisis it was seen that the amphotonia was increased for the two groups except for two symptoms for which we see no explanation: arterial and venous hypotonia. A patient of the vagotonic type behaved during the crisis like an amphotonic patient with sympathicotonic predominance. What practical data may be drawn from these laborious researches of which we shall not give all the details? The facts are interesting in themselves as they show the unruliness of the vegetative system during the visceral paroxysm but it shows also that it does not always influence the vegetative reaction and that consequently no matter how detailed these data on the vegetative system are they cannot constitute a criterion in choosing whether intervention shall be in the sympathetic or vagal system. A few clinical signs which we will mention seem to us to be of greater value.

The pharmacodynamic tests are no more final. Crises which are relieved by epinephrine are sympathetic in nature (Heile); those temporarily relieved by atropine are vagal in nature (Thomson). However in experimenting on cases chosen because they are rather definite clinical types of vegetative disorders we have been surprised before beginning our systematic research to find that within a few days the same patient had been helped and made worse by epinephrine given under almost analogous conditions. For this reason we have abandoned pharmacodynamic tests to determine the type of intervention required.

We wish to compare some of these clinical facts just reported with a few data found in the literature. We have shown that the radiculogastric evolution of the crisis has been remarkably well described by Head and Fearnside. On the other hand Foerster, Cotte, Jean, Critchley, and Wolfsohn have differentiated the vagal crisis from the sympathetic crisis in experiments on the biological reactions of the gastric juice and it is evident that a similar interpretation should explain in certain cases the benefit obtained from radicotomy and vagotomy and in certain other cases the complete failure. In a recent work Foerster insists again on that differentiation and its importance in deciding the type of operation. He would utilize the radiculospinal operation for

the splanchnic crisis and section of the sensory root of the vagus (technique of Foerster-Kuettner for the vagal forms). The tenth nerve has a mixed sensory and motor root.

Since 1911 Foerster has suggested the importance of the phrenic nerve in certain gastric syndromes of tabes. More recently he has completed his research and has concluded that affection of the phrenic causes a special type characterized by pain in the shoulder, hyperalgia of the neck and hiccough. This form does not include nausea or vomiting. Case 4 of our series justifies the separation of such a type at least from a clinical standpoint.

The general impression which we can draw however from our observations is opposed to a too strict separation of the different types: sympathetic, vagal, and phrenic. In most of the cases one finds symptoms belonging to three categories: the study of the vegetative tests shows the confusion of the two systems in the disequilibrium and the pharmacodynamic tests of Heile and Thomson do not solve the problem. We will see later that we can draw similar conclusions from cases in which we have operated.

#### THE MECHANISM OF GASTRIC CRISIS OF TABES

The gastric crisis of tabes is essentially an irritative syndrome of the afferent paths of the stomach either at the level of the spinal roots or at the level of the root of the vagus.

It is still undecided whether the stomach or any other abdominal viscus possesses true sensory fibers. However it is certain that the majority of the connectors of the gastric sensibility pass through the solar plexus, the splanchnic major, the ganglionic and vertebral chain, the white rami, and reach the cord through the dorsal roots from the sixth to the tenth or even the eleventh and twelfth.

At present there is no proof in favor of or against the existence of sensory fibers of pain in the trunk of the vagus. The failure of Exner's subdiaphragmatic vagotomy in the treatment of gastric crisis of tabes does not testify as Foerster says against the possible rôle of this nerve in the sensibility of the stomach. We know indeed that in the gastric crisis of tabes the painful irritation is not in the subdiaphragmatic segment of that nerve but in the root itself. The resection of the root alone (Foerster-Kuettner's operation) could make us decide on the rôle of the vagus in the sensibility of the stomach. Neither is it known whether the phrenic nerve contains any pain fibers from the stomach but clinically it seems to.

The topographic mechanism of pain as a symptom is thus elucidated. To explain vomiting one may admit an excitation of the vagus reaching the bulb and referred toward the periphery by the thoracic roots (influencing the diaphragm and the abdominal muscles) by the splanchnic nerve (innervating the stomach) and by the vagus (innervating the cardia). However we do not exclude strictly local reflexes at the level of the gastric mucous membrane itself: hypersecretion and vomiting going on even after suppression of all the afferent paths.

Gastric hyperkinesis evidently depends on stimulation of motor fibers at the level of the spinal roots as well as at that of the terminal ganglia. Nausea is a vagal syndrome and is probably caused by the excitation of the central trifurcal root.

Our knowledge of the metameric levels corresponding to different nerves affected in gastric crisis is relatively precise. The afferent and the efferent fibers from the stomach seem to enter the cord through the roots from the fifth to the twelfth dorsal. The fibers belonging to the phrenic nerve arise from the third, fourth and fifth cervical segments. The topography of the arcus is known.

Our knowledge of the segmental distribution of the cord dictates our surgical procedure.

Foerster called attention to the important role of the posterior root in the mechanism of gastric crisis. Posterior radicotomy of even a large number of roots has not been uniformly successful.

Therefore since 1911 Foerster has begun to resect the anterior roots. The role of the anterior roots in the conduction of sensibility has been sustained by Kidd (1911), Lehman (1909), Foerster (1909), Lehman (1920), Heind and Shaw (1909), Foerster (1914), Shaw (1905), Critchley and Wolfsohn (1926).

An extreme view is held by Lehman who believes that the anterior root alone conducts deep and visceral sensibility. This theory has been enthusiastically discussed by Frohlich and Meyer, Weizaecker, Mueller, Meyer and others. New research work on the subject has just been published by Meyer. His conclusions are very positive. The law of Bell holds true in man and all experimental work tend to prove that the sensibility goes exclusively through the posterior roots.

However Foerster expressed himself as follows:

The anterior and posterior roots contain the afferent paths. The posterior roots constitute the principal sensory system; section of them con-

stantly results in the production of sensory disturbances provided a sufficient number of roots has been sectioned. The anterior roots constitute an auxiliary pathway of sensibility; their interruption alone never provokes any appreciable sensory disturbance. However the fibers of the anterior roots may in a certain measure cover the sensory deficit resulting from destruction of the posterior roots. This compensatory action applies chiefly to deep sensibility but also in a less degree to cutaneous sensibility. The experiments of Shaw confirm the veracity of Foerster's opinion.

It seems however that the anterior and posterior roots are not alone concerned in transmitting visceral sensibility. Foerster who has had great experience in operating on patients with tribes has come to the conclusion following examinations made on patients in whom the posterior and anterior roots and even the lateral spinothoracic tract had been cut that there must also be an extraradicular route by which pain stimuli may reach the central nervous system. He explains this as follows: One must think of the possibility of pain stimuli being conducted from the stomach by way of the periaortic sympathetic plexus of the gastric vessels, the aortic plexus, the sympathetic trunk and from there to the cord by the corresponding rami communicantes (eighth cervical to third lumbar roots). As we have previously mentioned the question of whether or not the vagus carries painful impulse remains open.

#### THE RESULTS OF VARIOUS SURGICAL INTERVENTIONS

The peripheral operations (extirpation of the solar ganglion by Leriche, elongation by Jaboulay, isolation by Delbet and Mocquot) only partially remove the afferent and the efferent pathways.

Resection of the splanchnic nerves proposed by Jean and executed by Foerster and section of the rami cannot be depended on to effect a cure.

Section of the posterior and anterior roots combined with cordotomy is certainly the operation of choice in crisis with sympathetic predominance.

As far as vagal crisis are concerned subdiaphragmatic vagotomy is ineffective; section of the roots of the vagus proposed by Foerster and Kuettner has not been done sufficiently often to permit one to pass judgment on its merits. In one of our cases of the vagal type amelioration obtained by section of the thoracic roots has been so remarkable that for the time being we have decided to discard the various operations on the vagus nerve.

We have so far not had the opportunity of operating in a case of crisis of phrenic type and do not know that this operation has been carried out elsewhere.

After what we have said about the participation of the anterior roots the posterior ones and perhaps the ganglionic chain in the conduction of gastric pain it is obvious that both roots must be sectioned. This is accomplished by Foerster through the intradural route. We have tried to perform it by an extravertebral route which produces less trauma by combining section of the intercostal nerves with that of the *rami communicantes* in the paravertebral line.

#### THE TECHNIQUE OF NEURORAMISECTOMY

This technique for neuroramisectomy was suggested by that of Gazi. The patient is placed horizontally in ventral position with a pillow under the inferior portion of the thorax. The dorsal spinous processes are carefully located. If they cannot be palpated because of obesity, one may readily orient himself by the stunted nodular structure of the transverse processes of the last dorsal vertebrae after incision. In almost all the subjects which we have examined atrophy of the transverse process of the eleventh dorsal vertebra was well marked.

The operative field is disinfected. At about 3 centimeters outside the spinous processes one cuts successively the fascia of the *latissimus dorsi*, the inferior fibers of the trapezius, the *latissimus dorsi* and the superior fibers of the small serratus posterior inferior. The muscles are then retracted and one may view the transverse processes to which the numerous small muscles of the back are attached. These transverse processes are carefully cleaned with scissors and periosteal elevator. The next step consists in severing these processes as near as possible to the vertebral laminae and detaching them from their costal articulations. This step may provoke a certain amount of bleeding which comes from the posterior branches of the intercostal artery. In order to check this it is advisable to place a swab in the space thus created while one severs the process situated above or below.

The intercostal nerve is next located. To do this one cuts the fascia of the external intercostal muscle and enters the space situated between the internal and external intercostal muscles in which one finds mixed with fat and loose connective tissue the intercostal nerve with its vessels. One liberates it with a probe and holds it on a hook. The next step consists in isolating the *rami*. In order to do this the intercostal nerve must be

slightly stretched; one must stretch it only slightly in order to avoid injuring the cord.

By cleaning the intercostal nerve carefully with a probe one discovers the *rami* and often the spinal ganglion with the outer portions of the spinal roots. It is advisable to touch with the probe only the tissues which one sees so as to avoid injuring small veins and arteries nearby. One next respects the *rami* and the adjoining portion of the intercostal nerve. A few interrupted sutures will serve to join the muscular tissues and the skin may be sutured as the surgeon prefers.

#### ILLUSTRATIVE CASES

**CASE 5.** A man received the initial syphilitic infection in 1905. In 1910 he experienced uncertainty in walking and vesical symptoms. These manifestations were progressive. In January 1910 root pains of the shooting type appeared but were interpreted as sciatic pain. By 1922 the shooting pains had become marked in the lower extremities and were accompanied by a feeling of uneasiness in the epigastrium and a sensation of swelling deep in the area of the stomach and the left hypochondrium. In 1931 there were a few very painful crises in the right hypochondrium and troublesome bilious vomiting.

When examined in 1925 the patient was 31 years of age and in poor health. There was a general absence of tendon reflexes. Babinski's and Oppenheim's signs were present on the right, the cremasteric and abdominal cutaneous reflexes were absent. Ataxia in the lower extremities was marked. The patient frequently suffered from vertigo.

Ophthalmic examination revealed pupils of medium caliber on the left. The Argyll Robertson sign was incomplete on the right; it was complete. Headache was common. From a psychic standpoint the memory was failing and there was definite lack of interest; the patient was querulous. The stomach was dilated and there was difficulty in mastication in the epigastric region. Pain was present in the region of the gall bladder but the viscous was not palpable.

The gastroduodenal type of crisis predominated in the case. The crisis was extremely severe and lasted for several days during which the patient could not take any food. Nausea and vomiting were continuous and relieved after painful efforts in the evacuation of bilious liquid. Between the crises appetite was absent and if the patient made an effort to eat pyrosis and often vomiting followed, sometimes provoking a fresh crisis. On certain days the pain was localized in the right hypochondrium; there was nausea without vomiting, a tendency to fainting spells and hemiparesis or bilateral temporal pain.

Between September 1905 and January 1926 attempts were made to relieve the crises by various forms of treatment: Salvarsan, stovaine, morphine, bismuth, milk, intramuscularly and phallo combined with tuberculin were tried without success.

At neurologic examination in November 1925 it became apparent that an area of hypaesthesia from the tenth dorsal to the second lumbar cutaneous areas with an area of hyperaesthesia above the first or second shifted from day to day. In the hypaesthetic area even very strong electrical stimuli were without effect but a certain sensitivity to heat persisted. There was generalized diminution of sensitivity of the nerve trunks and of the viscera on pressure. On the left there was evidence of a



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In this case we had to deal with advanced tabes with thoracic radicular crisis gastrovesical crisis and sometimes vesical crisis of the vaginal type. All medical measures failed to bring about relief. The state of nutrition was extremely poor. Bilateral paravertebral anæsthesia suspended all the trouble immediately the first for 5 days the second time for 8 hours. Section of the eighth ninth and tenth dorsal roots on the left and the ramæ did not modify the root pain the sympathetic pain or the gastric crisis in the least. Section of the seventh eighth ninth and tenth dorsal nerves and ramæ on the right caused an instantaneous disappearance of the pain which was continuous for more than 3 weeks.

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Convalescence was uneventful and the patient was up on the fifth day.

A year after the first operation the patient appeared to be in excellent health. There was slight hypotonia of the muscles of the abdomen in the right hypochondrium with pilomotor areflexia and cutaneous anesthesia to pain and heat. There was a marginal area of hyperesthesia in the area innervated by the sixth dorsal.

In this case we had to deal with gastrovesical and sometimes intestinal crises which dominated the clinical picture. Section of the seventh eighth ninth tenth and eleventh dorsal roots and ramus on the right brought about immediate relief for 3 months. Because of the recurrence of the gastric crises we performed a similar operation on the fifth and sixth dorsal roots. The troubles disappeared entirely and the cure has persisted for more than a year.

**CASE 7.** A woman aged 59 years was married but had never been pregnant. Her husband had died recently following general paralysis. The date of the patient's syphilitic infection was unknown. The present illness began in 1920 with pain in the lumbar region which increased in intensity and frequency until it was typical of true severe crisis. For more than 5 years these pains resisted all kinds of therapeutic measures and there was not a week in which they did not occur. At the onset of the attacks there were eructations gastric heaviness and nausea for several hours but no vomiting and no real gastric pain. However these premonitory symptoms inspired terror because they were invariably followed by the true painful crisis characterized by violent shooting pain in the back from the sixth to the tenth dorsal vertebrae the pain radiating laterally to the axillary line and never reaching the gastric region. The pain was much more marked on the left than on the right. During the crisis which might last from several hours to several days the patient remained in bed and had absolutely no desire for food. Since 1920 constipation had been marked. The patient was emaciated and of a sallow color.

On examination the Argyll Robertson sign was observed. There was hyperesthesia in a region corresponding to that in which there was subjective pain; the patient was able to give the limits of this area with surprising accuracy. The knee jerks were abolished, the right ankle jerk was weak. Romberg sign was absent and there was no appreciable ataxia.

In order to determine the origin of the pain we injected a 0.5 per cent solution of novocain into the paravertebral spaces in which the pain was maximal that is from the sixth to the tenth dorsal nerves on the left and from the seventh to the tenth dorsal on the right. The stomach was observed by means of the fluoroscope before and after the injection. Before injection ptosis was marked the stomach was hypertonic emptied rapidly and a large air pocket was evident. After injection gastric motility was diminished and the passage of food through the pylorus was slow.

At operation November 26 the sixth seventh eighth ninth and tenth dorsal roots and the ramus on the left were severed. The effects were striking and immediate. Convalescence was uneventful and the patient was up 5 days after operation.

Six months after operation the violent pain on the left side had completely disappeared the pain on the right side had almost vanished except on two occasions on which there was only slight pain accompanied by the usual

gastric symptoms. There was a region of hyperesthesia on the left side with slight prickling in the area innervated by the nerves severed at operation. The patient's appetite was good the tongue was clean and the pasty taste was gone from the mouth. The constipation had disappeared and the bowels moved easily and regularly. Since operation the patient had gained 16 pounds and has been able to work.

In this case the predominance of root pain was marked visceral disturbances being only faint and introducing the crisis. Severing the sixth seventh eighth ninth and tenth dorsal roots on the left (the most painful side) with the ramus suppressed the pain on the left side entirely and on the right side almost entirely but it did not improve the slight gastric disturbance.

### CONCLUSIONS

Surgical measures in the treatment of gastric pain have generally speaking dealt on the one hand with the organ itself and on the other with the paths through which the painful impulses were thought to be reflected in the respective metameres.

These ideas may be applied to the gastric crises of tabes more than to any other pain. Clinical analysis of this type of pain reveals a radicular factor superficial and deep sympathetic elements and possibly vagal or phrenic participation. It is the uncertainty of these factors which may explain the failure to provide relief in all cases.

Clinical or pharmacologic criteria which would enable one to estimate the part played by these various factors and thus to determine appropriate treatment apparently do not exist. Clinical study leads us to make certain assumptions but efforts to determine the state of the neurovegetative equilibrium have not given us faithful results.

From a practical point of view the majority of tabetic crises are vagosympathetic in type.

From an anatomophysiological standpoint the tabetic crisis is an irritative syndrome of the gastric afferent paths either at the spinal roots or at the roots of the vagus. The posterior spinal root plays the chief rôle but we cannot exclude the anterior root from participation in this process through its sympathetic fibers. The part played by the sensory fibers in the vagus is still unknown.

A physiological operation for the relief of tabetic gastric crisis (since the participation of the vagus nerve is still unknown) should thus be directed toward the posterior sensory root and the sympathetic fibers of the anterior root the combined section of the two roots and the resection of the ramus answers these requirements.



- spherical processes into the ramification ante  
J Comp Neurol 1924 xvi 403-504
- 50 LUIZ A J The minimum of pliancy in  
Arch Neurol & Psychiat 1924 xi 445-461
- 51 SHAW P C A study of intra tabular function  
rhizotomy and pinal section Brit J Surg 1924 xi (45) 675
- 52 SICARD and DESMARETS Compt rend Acad  
internat de med 1913 xi 84
- 53 SOUTAR H S Division of right and left  
of the cord for relief of pain in tabes  
Proc Roy Soc Med 1916 iv part 38-43
- 54 SPILLER W G and MARTIN I The treatment of  
persistent pain of organic origin in the part  
of the body by division of the antero-lateral column  
of the spinal cord J Am Med Assoc 1912 li 381
- 55 STEWART TURNER Resection of the posterior  
nerve root Proc Roy Soc Med 1916
- 56 THOMSEN THOR Crises gastriques gueries par une  
syngonome Acta med Scand 1924 lx 66-73
- 57 VLRBRUG and FRAN Un nouveau cas de neurorami-  
ectomie pour crise gastrique tabétique Bruxell  
m d 1917 xvi 122-124
- 58 VLRBRUG and VAN BERCHELT LUDO Deux  
cas de neuroramiectomie pour crises gastriques du  
tabes Lyon chir 1924 xxiv 32-39
- 59 VILCER M H Sur une modification du chemin  
lemaire pour la conception physiologique des flex-  
ions ro-enitit de Macken J Proc med 1917  
li 8-3
- 60 VON KOELLICHER A J De feiner Bau und die  
Functionen des sympathischen Nervensystems  
Wuerzburg 1894 81 pp
- 61 WERSZACKER A Verland 37 Krong d deut ch  
Ce (ll ch f Un M d Wtschrft 1915 30-94  
Quoted by Meyer

THE FELTER YOKE AS A PROPHYLACTIC MEASURE FOR POSTOPERATIVE PRESSURE PARALYSIS FOLLOWING THE USE OF THE TRENDLENBURG POSITION<sup>1</sup>

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**D**URING the last part of the nineteenth and the first of the twentieth century paralysis was thought to result from anæsthetics and narcotics were discussed at some length by many writers both in this country and abroad. Since 1908 however there is very little available literature on this subject not because this condition has ceased to exist but because the majority of writers have agreed both as to the etiology and the best prophylactic measures to prevent such surgical accidents.

It is not the purpose of this article to contradict previous claims or to present any new theories as to the etiology of these paralyses but merely to describe three cases resulting from pressure of shoulder supports while the patients were in the Trendelenburg position and to offer the Felter yoke as a prophylactic agent.

Buedinger was one of the first to describe cases of paralysis of one or more extremities following operation. He reported 9 cases in 1894 followed in a short time by 3 more. In 1895 Krumm reviewed the subject and referred to articles by forty separate investigators. From then until 1908 many other reports may be found.

In discussing this condition the majority of writers agree that it is avoidable and that the most important prophylactic measure is the correct position of the arms during the operation, namely at the side or crossed upon the chest. There were a few Green for instance who argued that the paralysis was not due to pressure but to the direct toxic action of the anæsthesia. He reports a case of complete paralysis of the right upper extremity following operation for cholelithiasis performed under chloroform and points out that the arms were folded upon the chest throughout the operation.

The two types of paralysis which must be considered are the central and the peripheral. The former is quite rare and is due to an ischæmic often secondary to a hæmorrhage or to primary degeneration the result of a toxic action of the anæsthetic upon the cerebral cortex (Halstead). Hersman expresses the view of the majority however when he says "Paralysis following an anæsthetic which are due to that agent alone are more imaginary than real."

It is the other type, the peripheral and especially that of the brachial plexus that comes within the scope of this article. Undoubtedly the position of the arms is an all important matter as most of the reports state that the arms were displaced upward and backward over the head during the operation. With the arm in such a position the clavicle is drawn upward with a resulting compression of the cord of the brachial plexus between the clavicle and the first rib. With marked abduction of the arm the clavicle rotates so that its posterior superior border becomes its posterior inferior border and in this way decreases the available space between the clavicle and the first rib.

Other conditions that predispose to a postoperative paralysis as pointed out by Ileszynski are extension of the head toward one side thus stretching the nerve trunks, the position of the arm under the head or body during a long operation, the position of the arm or leg over the sharp edge of the operating table thus causing pressure on one or more of the peripheral nerves, pressure on the part of the anæsthetist with fingers or elbows upon the region of the brachial plexus and finally pressure from metal clamps or tight strips over the shoulders or lower extremities. Our cases all fall into the last group as in each case the arms were folded upon the chest and metal braces were used to support the shoulders.

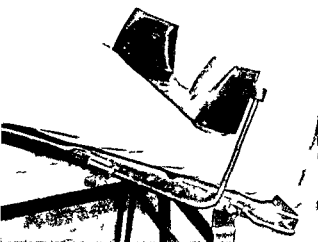


Fig. 1 Operating table with yoke attached showing method used for adjusting position of yoke to fit shoulder

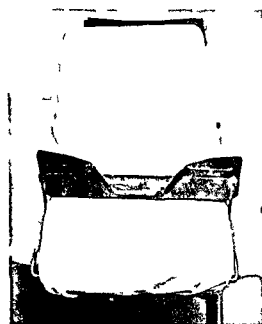


Fig. 2 View of yoke from end of table showing metal rights in position

operating table by traction in the axilla is responsible for a small percentage of these palsies and should be discouraged.

The point at which the brachial plexus is compressed varies as can be seen in the difference in the resulting paralysis. It may vary from the compression of a single cord to a compression of all of the trunks of the plexus. The fifth and sixth cervical roots are more often involved as they cross the first rib causing an Erb's type of palsy involving the deltoid clavicular portion of the pectoralis major brachialis anticus biceps supinator longus and not infrequently the supra spinatus and infraspinatus muscles (Turney)



Fig. 3 Patient supported by yoke. Arms are folded over chest during the operation



Fig. 4 View of patient in deep Trendelenburg position showing even distribution of pressure upon the shoulder. As in Figure 3 the arms should be folded upon the chest

The point at which pressure will cause this injury is located one inch above the clavicle at the posterior border of the sternocleidomastoid muscle. The seventh and eighth roots may be damaged in the same way or by being stretched over the head of the humerus.

CASE 1. Mrs. E. M. G. aged 45 married weight 135 pounds mother of 5 children entered the hospital on November 2, 1926 because of abdominal pain and menorrhagia. Examination showed the fundus to be larger than normal and revealed a mass in the right broad ligament. On November 30, 1926 the patient was operated upon and a hysterectomy and bilateral salpingo-oophorectomy were performed for a tubo-ovarian abscess.



the side or folded upon the chest. There should be no pressure in the popliteal space when the patient is in the Trendelenburg position and when using deep Trendelenburg especially as deep as is necessary for gynecologic operations a suitable shoulder support should be used. By suitable is meant one that will not cause pressure upon one small area but which will evenly distribute the pressure across the shoulders.

It is believed that the Felter yoke fills these requirements very satisfactorily. It was designed by Miss Felter operating room nurse in Dr W. W. Chipman's Clinic at the Royal Victoria Hospital in Montreal and acknowledgments are made to him for permission to describe the yoke in this article.

The accompanying drawings and photographs are it is believed self explanatory (Figs 1-5). The yoke may be constructed of any kind of wood. The one made for this clinic is of birch carved to fit the shoulders heavily upholstered and encased in a rubber covering to prevent soakage from blood and vomitus. It can be made by any carpenter to fit practically any modern operating table. It is attached to the table by two metal uprights which are angled at 90 degrees and pass through metal cylinders one of which is permanently riveted to the table upon each side. A set screw is placed in each of these cylinders and by means of these the yoke can be adjusted to fit any length patient. The space for the neck is cut in a gradual curve and measures 7 centimeters in its greatest width. The yoke is 9 centimeters wide and 9 centimeters high. This yoke has been in use in this clinic since June 1917 and has proved very satisfactory and as yet no postoperative pressure paralyses have developed.

## CONCLUSIONS

1 Postoperative brachial paralysis is not common is usually temporary but may persist for years or indefinitely.

2 It is usually due to pressure and is avoidable by proper position of the arms proper position of the anesthetist and by a well fitting shoulder support when the Trendelenburg position is used.

3 The Felter yoke causing an even distribution of pressure seems to be a most advantageous form of shoulder support and being of simple construction can be made by any hospital carpenter.

## BIBLIOGRAPHY

- ANDREWS H. P. Oxford Loose Leaf Surgery 1906 vol 1  
 P 113  
 BOUCHT K. Fin ka lak s lsk handl x ix 109 ab  
 tracted Zent bl f Chir 1898 x v 908  
 BRAUN H. Deut che m d Wehn chr 1894 49  
 BUDINGER K. A ch f klin Chir 894 xlvii 2  
 CAE Bull Acad roy de m d Belg 1891 47  
 COTTON ALLAN Boston M & S J 1903 c lvi 499  
 CRISSEN H. A. Gynecology f r Nu es 220  
 DEFOREST H. P. Ann Sug 189 x x 97  
 DUVAL P. and GULLAIN G. Gaz heb d med 900  
 xlv 649  
 JLATOV Zentralbl f d C enz eb d Mel u Chir  
 90 i 38  
 CARRICUP H. J. Am J M Sc 189 c iii 81  
 CRIEN W. F. Tr Am Inst H meop 90 i iii 49  
 HALTHAM A. I. Surg Gynec & Obst 90 vi 91  
 HERSMAN C. C. J Am M As 190 xvi 3  
 KRUMH L. Samml klin Vor 1895 N 130 ar  
 tracted Ann Surg 897 xv 93  
 LESZYNSKY W. M. Med Rec 1899 l i 583  
 Idem J Ner & Ment Di 1899 x vi 699  
 MALLY I. ev de chir 1899 x x 9  
 MCCOSH A. J. Ann Surg 902 x x x 109  
 PLACZKA Berl kli Wehn sch 189 x 286  
 SEHRWALD I. D utsche med Wchnsch 190 xvi 98  
 TURNER Clin J 899 vi 185  
 VAUTRY Méd m d Lar 189 vi 52  
 WILK R. I. Med New 901 l vi 11



## VARICOCELE<sup>1</sup>

## A STUDY OF FIVE HUNDRED CASES

BY MR JUDITH F CAMPBELL M D NEW YORK

$\lambda \quad l \quad t \quad g \quad N \quad y \quad kN \quad y \quad d(h)l \quad H \quad p \quad tA \quad t \quad tA \quad i \quad gS \quad C \quad I \quad t \quad t \quad Adj \quad U \quad l \quad g \quad lS \quad g$

**V**ARICOCELE is characterized by elongation, dilatation and tortuosity of the veins of the pampiniform plexus the permatic not infrequently showing this condition with the remasteric and deferential vessels. Symptoms in present are predominantly those of sexual neurasthenia. For this reason surgical treatment is apt to be resorted to in place of common sense. Varicocele is observed chiefly in young adults and in most of these it disappears symptomatically at least by the time the patient is 35 years old. In private practice particularly of urologists patients presenting symptoms sufficiently severe to warrant operation are rare perhaps one or two a year. On the other hand in large hospital we have constantly before us those seeking this operation a large number of whom so to fulfill certain physical requirements for national defense organizations (Army, Navy and Marine Corps), local municipal departments (Fire Police, etc.). Of the 500 cases of varicocele here reported from the Urological Service of Bellevue Hospital one fourth fall in this category. The large number of the asymptomatic case subjected to seemingly needless surgery stimulated our study and observations on all phases of varicocele among these 500 cases are here presented.

Two types of varicocele are recognized (a) spontaneous idiopathic or primary and (b) secondary. Secondary varicocele results from spermatic vein obstruction by intra abdominal tumors most often of the kidney but occasionally large carcinomata of the pelvicretal region rarely retroperitoneal tertoma or sarcoma. Such varicoceles appear suddenly on either side grow rapidly to great size cause little discomfort and are usually presented by elderly patients bearing a palpable abdominal mass. Pepper (16) cites a case in which the sudden appearance of a varicocele heralded a spindle cell renal sarcoma 6 months before this tumor was recognized clinically. White (22) saw an acute left varicocele of 6 weeks duration disappear immediately upon removal of a pyonephrotic left kidney. I especially note the sudden appearance of right sided varicocele suggestive of abdominal tumor. Varicocele of obstructive origin is readily diagnosed when the patient is placed in the prone position when we note that the veins do not readily empty them-

selves as in the primary type. Removal of the obstructing tumor mass constitutes the treatment.

Spontaneous varicocele is the type commonly seen. Usually the etiology is obscure or unknown. Undeniably age is a factor for while we had 3 cases 12 years old and 1 case 59 years old over 90 per cent of our patients (Table I) were between the ages of 15 and 35 the period of greatest sexual potentiality. Nearly all were unmarried and had opportunities for sexual relief inadequate to their desires which serves to perpetuate a constant genital congestion. Abuse by sexual excesses or masturbation may also result in this condition. By analogy some gynecologists believe that such continuous congestion is a definite factor in the production of varicocele of the ovarian pampiniform plexus (usually left!) which not infrequently is accompanied by symptoms similar to those attributed to varicocele. Although most young adult males are subjected to sexual influences conducive to chronic pelvic congestion but in 10 develops varicocele. Billroth (3) believed this to be dependent on a peculiar diathesis first affecting the vessel of the pampiniform plexus later those of the leg and rectum. Prima (17) has recently suggested that varicocele is merely one manifestation of a generalized substandard condition. Such hypotheses do not explain unilateral involvement—over 90 per cent are left sided. In this series we found but 1 on the right side alone 10 were bilateral.

For years this left sided preponderance has been explained on the well known anatomical basis viz (a) the left testicle hangs lower than the right (b) the left spermatic vein is longer and (c) empties into the left renal vein at right angles and possesses either no valve or at least valves which are inefficient to support the spermatic column of blood. On the right side the vein is slightly shorter empties directly into the vena cava at an acute angle and therefore possesses efficient valves. Anatomical mensuration reveals the left spermatic vein to be normally but 15 to 5 centimeters longer than the right hence it seems more reasonable to believe that the physico-anatomical factors if any are solely those of efficient valve function on the right side. Vascular dysfunction is more common in old men in whom varicocele is rarely encountered but leg varicosities and hæmorrhoids

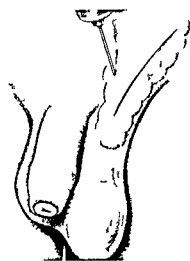


Fig. 1

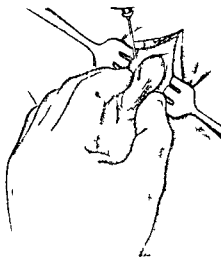


Fig. 2

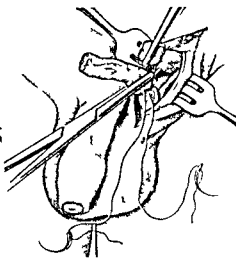


Fig. 3

Fig. 1 Infiltration and site of the incision for ligation. The incision is made high in the scrotum and extends somewhat above the level of the external inguinal ring.

Fig. 2 After the funicular sheath with its remaster covering has been exposed the cord which is still in its bed is well infiltrated. Injection made high through

the internal inguinal canal will give a most satisfactory block anesthetic.

Fig. 3 Excision of the varicocele. Attention is directed to the transfixion ligature on the proximal venous stump. The distal ligature ends are left long so as to be utilized as indicated in Figure 4. The vas with its artery and one or two veins is undisturbed.

rhoids are frequent. Chronic constipation with an overloaded sigmoid obstructing the spermatic vessels has also been advanced as a cause but this condition also is characteristically a disease of advancing years. Therefore while the actual cause is unknown it is certain that chronic passive genital congestion is a most important if not the underlying factor as is demonstrated by the rapid disappearance of most varicoceles with the assumption of the normal sex relationship of marriage. In other words marriage symptomatically cures most varicoceles.

#### PATHOLOGY

Venous tortuosity and dilatation form the pathological picture in the early stages. Later fatty atrophy endophlebitis and not infrequently phlebolith formation ensue. Connective tissue hyperplasia between the distended vessels accompanies the congestion. Moderate varicosities do not involve the testicular blood supply but with more extensive vascular changes the testicle circulation may be impaired and atrophy of this organ result (7 times in this series). Testicle changes are those of fatty degeneration followed by atrophic sclerosis. It has been stated that with dilatation of the veins about the nerves there is an associated periphlebitis and neuritis accounting for both testicular pain and atrophy. Anatomically three venous groups are recognized in the spermatic cord the anterior having in its midst the spermatic artery is the first to be

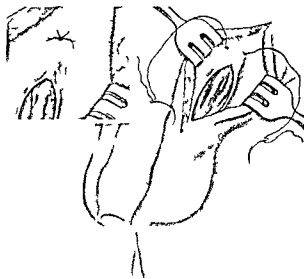
affected and constitutes the main body of the varicocele mass the middle or those surrounding the vas deferens and the posterior passing upward from the tail of the epididymis. Occasionally in old men varicocele of the posterior group involving particularly the tail of the epididymis results in sclerosis of the lower pole of the testicle. We have not recognized such a case.

#### SYMPTOMS

Acute varicocele may follow violent strain and is usually accompanied by severe local pains. We have seen it three times.

Otherwise the onset is gradual many patients bearing varicocele are totally free of symptoms even though the lesion be of considerable size. Too frequently the symptoms are those of sexual neurasthenia viz marked depression nervousness headache lack of concentration impotence vasomotor disturbances characterized by pallor cold moist hands or occasional flushes and lastly but perhaps most important an irrepressible anxiety complex or fear of either a defective genital apparatus or the loss of sexual function. These and a variety of generalized aches and pains out of all proportion to the objective findings are common. Such patients usually display marked modesty on examination and complain of tenderness of the testicle and cord on manipulation.

Of uncomfortable stimuli produced by varicocele the most frequent is a dragging sensation in



1 4 11 1 m 1 t m 1 l 1 1 1 k  
t th l p d d t l f m l h  
t t t m p p d d t l t l b th  
t t l 1 l f l t t t l m h t  
t m t l h th t m l t  
h p h th p l t t l h t t l  
j m l t m j l t l

the testicle often referred to the cord groin  
lower left abdominal quadrant left lumbar region  
epigastrium or along the shaft of the penis. Also  
scrotal aching testicle pain may be constant some-  
times aggravated by standing walking or work-  
ing. Two of our patients (one a skating instruc-  
tor) had to give up their customary employment  
because of extreme pain. In two others the pain  
was referred to the epigastrium producing re-  
peated attacks of nausea and vomiting. Curiously 12 pa-  
tients allege their symptoms to be aggravated by  
warm weather—a vas dilatation being probably  
the explanation. Scrotal burning after defecation  
in one case and burning in the testicle in tw  
instances are characteristically the symptoms of  
neurosis. One hundred twenty-eight sought  
operation to fulfill certain physical requirements  
for civil service army etc. practically all of  
whom were asymptomatic many ignorant of the  
lesion until apprised of its presence by the  
examining doctor.

TABLE II—DURATION OF VARICOCELE (AS  
NOTED BY PATIENT)

U	l	3	n	tl		6
at	(	m	tl			39
(	t	m	th			46
t	t					66
t	3					3
3	t	5				
5	t	5				
5	t	5				6
O	t	5	y			8
I	f					8
M		3	y			9
N	t	t	t			9

Objectively one notes a relaxed scrotum alw  
hanging left to ticle with the outline of the tor-  
tuous veins often visible against the scrotal wall.  
Palpation discloses the typical bag of worms  
feeling, which can be confused with no other  
lesion except rarely omental hernia. At times  
small phleboliths are encountered. The testicle  
occasionally shows atrophy noted by some with  
incidence as high as 11 per cent (17) in our series  
a trifle over 1 per cent (Table II). Scrotal varices  
are also found sometimes focusing attention to  
the accompanying varicocele by their presence or  
by rupturing as in one case of ours. Varices of  
the wall may also induce annoying scrotal itching.  
A thickened epididymis is a common finding and  
whether it is associated with the chronic conge-  
stion or results from infection is not known.

#### DIAGNOSIS

Omental hernia is perhaps the only condition  
apt to be confused with varicocele and we may  
rule this out by having the patient lie down and  
noting the emptying of the scrotal veins. When er  
is placed over the external inguinal ring and  
when the patient rises the omental hernia will be  
held back while the veins again fill. Many varico-  
celes are associated with inguinal hernia (40  
times in this series) but the presence of the latter  
should not make diagnosis difficult. Hydrocele of  
considerable size may obscure the varicocele.

Most men lose their varicoceles after marriage.  
Rarely does the lesion persist although sometimes  
progressive enlargement continues terminating  
perhaps in atrophy of the testicle.

appear after a period of years and that most of the men complaining of varicoceles are neurotics and are not relieved by operation.

We recently confirmed Bloodgood's observations in a study of a group of 150 men under 30 years of age and another group of 150 over 50 years of age. We found that of the first group 9 had moderate sized varicoceles in 4 of whom the lesion produced symptoms. Of the group over 50 years 4 had anatomical varicocele none complained of symptoms and 6 gave a history of having suffered with varicocele in early life but stated that the condition had since disappeared. None of these 6 had been operated upon.

Bloodgood and later Douglas (8) pointed out the severe complications which may result from varicoectomy—hemorrhage infection epididymitis hydrocele and most particularly loss of a functioning testicle by atrophy—all presumably to no benefit. In a careful follow up in 106 of 30, cases operated on for Army enlistment Douglas found but 48 per cent normal after a postoperative intermission of many months 39 per cent had hydrocele and 4 had atrophy. With this cheerless anticipation one considers surgical treatment.

Therapeutically as well as clinically three types of varicocele are recognized. The first type asymptomatic varicocele whether large or small is best left alone since operation frequently induces numerous subjective symptoms leading ultimately to a definite neurosis. Most of these patients are unaware of the lesion until it is demonstrated by an examining physician. Most of the 128 cases operated on at Bellevue for enlistment or civil service fell in this class these patients are operated on against one's better judgment. The second type denotes its presence by scrotal enlargement and a feeling of weight or a dragging sensation either in the scrotum (testicle) or referred to the cord groin loin etc. These cases are uniformly benefited by operation and constitute the type in which operation is definitely indicated. The majority of varicoceles fall in the third group—those which are small yet which may be the determining cause of a sex psychosis progressively undermining both mental and physical stamina. These patients are a serious problem their symptoms and reactions are characteristically alike. Anxiety regarding the integrity of their sex apparatus is their first concern. Not infrequently they plead for an operation but in the same breath refuse to give their consent for fear of surgical injury to the testicle. They are entitled to not a little patience on our part and an explanation of the origin and mechanism of varicocele with the assurance that the condition is not

TABLE III — ASSOCIATED SURGICAL CONDITIONS

CASE	CASE
Hernia	
Right	3
Left	49
Bilateral	14
Scrotal varices	5
Hydrocele	
Left	4
Right	1
Stricture urethra	1
Spermatocele left	1
Movable right testicle	1
Circumcision	23

a serious one and that after marriage it will probably disappear. Patients who are refused or who refuse operation easily fall prey to the charlatan or unscrupulous practitioner who encourages the patient's notion that varicocele will cause lost manhood.

At Bellevue Hospital we operate perforce on many of these varicocele neurotics. They will not help themselves and if not operated upon allow themselves to progress to an ill fate.

We do not operate on asymptomatic patients however unless they have been sent in by surgeons of the various municipal departments particularly the fire and police departments. A short time ago we addressed a letter of inquiry to the chief surgeons of these departments to ascertain the rationale of operation in these asymptomatic cases. No reply has been received to date. To a similar inquiry Surgeon General E. R. Stutt U. S. N. answered. It has been our experience in the Navy that it is not the large varicoceles that cause symptoms but rather the small ones and they are usually associated with neurasthenia or hypochondria. Such patients repeatedly apply for treatment until the condition constitutes a disability for efficient service. \* \* It has been my custom as Surgeon General when candidates for the Academy have been rejected because of varicocele causing symptoms to advise against operation and in most cases this defect is waived unless it is associated with certain other disqualifying defects. It is of course realized in the case of enlisted men that it may be a convenient excuse for malingering. Lieutenant Colonel J. F. Siler of the Surgeon General's Office War Department replied. Varicocele is not a bar to enlistment or commission unless it be large or painful. An enclosed tabulation indicated that in the Army 8,736 days of hospitalization were caused by varicocele from 1922 to 1926 inclusive further evidence that the condition merits serious consideration.

Operation is indicated then in cases of large varicocele causing symptoms—particularly the e

TABLE IV—SYMPTOMS (SUBJECTIVE)

V	c c l
Sw	ll g
D	agg g
P	n
C	nst t
	(t pped k )
O	t
O	st d g
I	t m tt t
A	l g p
P	f d t
G	
L	mb g
E	p g t m
	(w th )
L	w lt q d t
B	g t t t l
S	t l b , aft d f t
S	t l t h
R	pt d c t l c
C	l
Sympt	m j t w m th

of weight or drag—in which atrophy of the testicle is feared. Operation is indicated in the third group—the small varicocele with symptoms out of all proportion to the objective findings—only if correction of sexual hygiene is hopeless psychotherapy has failed or the wearing of a suitable scrotal suspensory has given no relief. In the German Army (23) operation is performed only when a suspensory fail to relieve. Sanford (19) cites as other indications for operation absence or disease of the opposite testicle complicating hernia or hydrocele of the same side a history of recurring phlebitis thrombosis spontaneous rupture or calcareous condition of the veins.

## OPERATION

In most cases local anæsthesia is the anæsthetic of choice. An excessively neurotic patient may demand general anæsthesia as occurred 6 times in our series. In some of our earlier cases complicated by herniotomy general anæsthesia was given but we now do these under regional block.

While I have had no experience with the procedure others have found that resection of the scrotum for varicocele neither cures nor relieves since the remaining sac containing the heavy venous mass soon attains its former size.

Subcutaneous ligation devised by the elder Keyes (14) relieves varicocele detains the patient in bed but a day or so but does not relieve pain. Moreover it is a blind procedure not without danger of trauma and hemorrhage and at present is rarely employed.

For novelties in varicocele operations one must look to the European surgeons. The underlying

TABLE V—PHYSICAL EXAMINATION

C	C d t	C
57	T t cle	
8	At phy	
98	Sl ht	
	M d t	3
95	M k d	3
	Inla g l	
8	Te d	7
	Ep d dym s	5
	Ind t d	

principle in most of these procedures is ample suspension of the testicle thus relieving the vas of the weight—the cause of most of the pain more particularly cord pain. This suspension is brought about by various methods as for instance transverse suture of a longitudinal incision of the cremasteric fascia (19) or deviation of the course of the spermatic cord by (a) (14) creating a new and higher internal inguinal ring or (b) suspending the cord through a fascial flap in the external oblique—all without excision of spermatic vessels (21). Fiorini combined excision of the spermatic veins with eversion of the tunica vaginalis and suspension of the testicle to the pillars of the external ring. Amorosi (1) and Jacob (13) also described orchidopexy the operation of the latter differing in minor details from that devised by Vincent at about the same time (1918) on the Urological Service at Bellevue Hospital. This remains to the present our standard procedure for varicocele. Vincent's operation is recorded only by Keyes (14). The following is a description of the method.

After novocain infiltration (Fig 1) a low hernia incision exposes the external ring and the emerging spermatic cord. Further cord infiltration is usually advisable at this point (Fig 2). The vessels are exposed by a longitudinal incision through the cremaster and the funicular sheath. The anterior vessels are separated from the deferential group as high as the external ring and down to a point which when raised to the level of the external ring will elevate the testicle about 2 centimeters higher than it normally hangs. These mobilized anterior veins—constituting the main body of the varicocele—are divided between clamps (Fig 3) and each is tied securely with a transfixion ligature at least 1 centimeter from the cut end so that the ligature will not slip off. The ligature of the proximal stump is cut short and this part is dropped back into the inguinal canal where it retracts from sight. On the other hand the ligature on the distal stump is left at least 6 inches long. The intercolumnar fascia is now divided and with a knife handle or grooved director a path is burrowed underneath the external

oblique to a point opposite the internal inguinal ring. The long ends of the ligature each threaded on a blunt or aneurism needle are introduced into the inguinal canal under guidance of the director or knife handle and at a point opposite the internal ring are separately pushed through the aponeurosis of the external oblique. They are then tied over the few intervening strands of aponeurosis (Fig. 4). The tying of this ligature pulls the distal stump up into the inguinal canal thus elevating the testicle about 3 centimeters higher than its usual level and relieving the vas of all tension. The wound is closed without drainage.

We then apply the Bellevue scrotal suspensory (5.6). This dressing affords both testicle splinting and suspension until the upper portion of the elevated venous stump becomes partially fibrosed to its new inguinal position. Unless this support is applied there is likely to be slipping of the suspended organ even though chromic suspension sutures are employed. This method was followed 398 times in this series. In the remainder the generally used end to end tying of stump ligatures after venous excision was performed. Five days in bed postoperatively usually suffices the average period of hospitalization in uncomplicated cases was 6.4 days.

We are careful in performing varicoectomy to keep away from the tunica vaginalis unless it is to be opened for hydrocele as trauma will increase the probability of subsequent hydrocele. In elevating the testicle if one carelessly pulls too hard the tunica vaginalis will not infrequently be found presenting in the wound an excellent position for traumatization.

#### COMPLICATIONS

Hydrocele is the most common complication of varicoectomy and as already indicated follows injury to the tunica vaginalis. The specific gravity of such hydrocele fluid proves that it is not a transudate resulting from vascular disturbances as alleged by some. Transudates are characterized by a low specific gravity 1.002 to 1.006 hydrocele fluid registers 1.020 to 1.026 or that of an inflammatory exudate—in these cases of traumatic origin. Hydrocele as a sequela of operation for varicocele was found in 39 per cent by Douglas (8), 30 per cent by Bloodgood (4), and 23 per cent by Corner (7). We have been able to follow personally but 42 patients in this series. Of these 4 developed hydrocele—were moderate sized (estimated at 5 ounces) the others were small (15 cubic centimeters). Perhaps our small number of hydroceles following varicocele operations is explained by the care employed to operate in the

TABLE VI—SURGICAL TREATMENT

	C
Anæsthesia	
General	1
Local	479
Type of operation	
End to end	102
Suspension and excision	398
Scrotal r. section	2
Additional operations	
Hydrocele	5
Hernia	46
Spermatocele	1
Complications	
Infection	
Suppurative	55
Deep	34
Hæmatoma	7
Epididymitis	
Acute	1
Subacute	4
Cut vas	1
Venous thrombosis	1
Slipped ligature with severe retroperitoneal hæmorrhage	1

inguinal region and to avoid trauma of the tunica vaginalis.

Atrophy of the testicle is with one exception the most serious complication. In the 42 cases followed 1 a medical student showed marked atrophy, 2 showed moderate atrophy. Bloodgood in studying hermiotomy with resection of the veins found atrophy in 15 per cent of 61 cases without resection in 1 case in 109. Corner found the testicle smaller after operation in 21 per cent.

Hæmorrhage may be the most serious complication as in one of our cases. A boy 6 years old complaining of scrotal enlargement and testicular pain for 10 years was operated on by a member of the house staff who performed the routine varicoectomy with suspension of the testicle. Fifteen minutes after returning to bed the patient found his scrotal dressing soaked with blood. He was returned immediately to the operating room and given a general anæsthetic. The wound was reopened and it was seen that the bleeding came through the external ring but the source was not disclosed until the lateral abdominal wall was widely opened and the peritoneum pushed back. This revealed the freely bleeding and greatly retracted proximal venous stump from which the ligature had slipped. After a ligature had been properly applied and a large amount of blood had been evacuated the wound was closed with drainage. The patient promptly developed a deep infection which for some time was most threatening but eventually healing was completed. Free and speedy retroperitoneal exposure is required in such cases. Fagge (9) reports a similar instance in which slower bleeding produced a flank mass with

TABLE VII—FOLLOW UP CLINIC

Hydr cele	C	8
At phy		4
Gon d ult		3
R c e ce		3
O c s lp		3

fever. It was diagnosed as a hypernephroma but exploration enabled evacuation of over 60 ounces of retroperitoneal blood clot with ultimate healing. Localized hematomata from wound bleeding are usually not alarming although we saw one which extended suprapubically for 3 inches down along the penis enlarging this organ to thrice its normal size and into the scrotum where its size became less evident. Scrotal resection for superficial varices in addition to varicoectomy with suspension in two cases was followed by scrotal hematoma, one case requiring evacuation of the clots. Scrotal resection is rarely if ever indicated.

Infection often follows healing. Deep infection usually associated with hematoma followed operation in 34 of our cases. One wisely avoided handling the skin in performing varicoectomy as it is practically impossible to sterilize the skin of the scrotum and lower groin.

Postoperative induration is frequently noted but nice attention to hemostasis will obviate most of this. Skillern (10) devised an operation said to eliminate induration—a complete resection of the anterior veins from the internal inguinal ring to the testicle without disturbing the vas in its bed.

Acute epididymitis followed operation in 3 days in 1 case. Subacute epididymitis developed in 4 others. Once the unidentified vas was accidentally cut but it was immediately sutured. Venous thrombosis was noted once. In a case of Keyes (15) several surgeons failed to make the diagnosis of pampiniform plexus thrombosis because never having felt such a thing before they were unwilling to permit their fingers to make the diagnosis. Removal of the clotted veins was followed by good result.

Testicular pain was complained of by 3 of the 42 follow up cases. In one a suspensory brought relief. In another the discomfort was noted in hot weather only. Of patients followed by Barney (2) 36 per cent still had pain, 27 per cent had a sex neurosis and 15 per cent suffered a recurrence. In our series the operation was performed in 9 cases originally operated on elsewhere. We are not aware of recurrence but if we were able to follow more of our patients probably many more complications and undesirable sequelæ could be recorded. However, this operative procedure as used at

Bellevue has proved far superior to other methods more commonly employed and because it does uniformly relieve testicular pain and drainage which are the chief symptoms of varicocele we believe it to be the technique of choice.

## SUMMARY

The etiology of varicocele is not clear but in most cases varicocele is associated with chronic genital congestion induced by faulty sexual hygiene. Of the 500 cases here reported 9 of every 10 were between 15 and 35 years of age. Advancing years or marriage symptomatically cure most varicoceles. The right side is but rarely involved. If the lesion is large and of long standing testicular atrophy is frequently observed. The bearing of worms feeling elicited on palpation of the pampiniform plexus establishes the diagnosis. Clinically and therapeutically three types of varicocele are recognized: (1) asymptomatic varicocele of which the patient is unaware. These are best left alone. (2) Moderate or large sized varicocele. Its presence is denoted anatomically by scrotal enlargement and symptomatically by a feeling of weight pain or a dragging sensation either in the testicle or referred to the cord, groin or loin. Operation benefits these cases. (3) Small varicocele which causes symptoms disproportionate to the objective findings. Most varicoceles are of this third type. The patients are broadly grouped as sexual neurasthenics. They are best treated by the institution of common sense sexual and physical hygiene. A scrotal suspensory will relieve many. In this type of patient operation is usually unsatisfactory as the symptoms persist after operation.

The suspension operation devised by Vincent on the Urological Service at Bellevue Hospital is the procedure of choice because it uniformly relieves pain and testicle drag and postoperative sequelæ are minimal. Hydrocele and atrophy of the testicle are the most frequent postoperative complications. Hemorrhage from the spermatic vessel may be most serious. It should be remembered that the tunica vaginalis may be injured without presenting itself in the operative field and care to operate high on the cord with a minimum of manipulation will do much to diminish the incidence of postvaricoectomy hydrocele. Atrophy following operation in a moderate number of cases. Employment of transfexion suture about the resected spermatic cord vessels will eliminate severe hemorrhage. After operation testicular support is very essential for at least 10 days. The patient is usually confined to bed only for from 5 to 7 days.

## BIBLIOGRAPHY

- 1 AMOROSI P Radical cure of varicocele with or without  
pery Polyclin sez prat 1922 xxiv 1621-1625
- 2 BARNEY J D Varicocele an analysis of 493 cases  
Pub Massachusetts Gen Hosp 1910 iii 335
- 3 BILROTH Quoted by White and Martin Genito  
Urinary Surgery Philadelphia J B Lippincott  
Co 1918 367
- 4 BLOODGOOD J C Warning against operating for  
varicocele on applicants for enlistment registrants  
for selective draft and soldiers J Tennessee M  
Ass 1918 x 469
- 5 CAMPBELL M F Treatment of acute epididymitis  
Ann Surg 1927 lxxvi 577-590
- 6 COLLINGS C W Scrotal bandages J Urol 1922 ii
- 7 CORNER Ligation of the spermatic artery in the  
operation for varicocele Lancet 1911 ii 1094
- 8 DOUGLAS JOHN Results of varicocele operation J  
Am M Ass 1921 lxxvi 716
- 9 LAGGE C H Retroperitoneal hematoma after radical  
cure of inguinal hernia and varicocele Brit J  
Surg 1920 vii 342
- 10 FIORINI E Clinical and experimental contribution to  
treatment of varicocele Polyclin sez prat 1914  
xxxi 1195 1198
- 11 FRANK E Surgical treatment of varicocele  
Zentralbl f Chir 1925 liii 2483-484
- 12 ISNARDI L Operation for varicocele without injury to  
the spermatic cord or scrotum Zentralbl f Chir  
1911 xlviii 1382
- 13 JACOB O Surgical treatment of varicocele Rev de  
chir 1919 lvi 352
- 14 KEVLES E L Urology New York D Appleton &  
Co 1924 751
- 15 Idem Personal communication
- 16 PEPPER O H P Necrotic onset symptoms varico-  
cele as first sign of sarcoma of kidney Med Clin  
N Am 1926 x 29-36
- 17 PRIMA C Treatment of varicocele Zentralbl f  
Chir 1915 lii 2244-2245
- 18 QUENU Quoted by White and Martin Genito  
Urinary Surgery Philadelphia J B Lippincott  
Co 1918 368
- 19 SANFORD H I Varicocele Cabot's Urology Phila-  
delphia Lea & Febiger 1918 484
- 20 SKILLFERN P J Jr Consideration of varicocele opera-  
tion and avoidance of postoperative induration  
Ann Surg 1920 lxxii 508
- 21 TURNER P Treatment of varicocele by excision  
Lancet 1911 i 59
- 22 WHITE Brit M J 1914 ii 177
- 23 WOLF Erfahrungen mit der von Nilson angegebenen  
Modifikation der Marathischen Varikozelenopera-  
tionen Deutsche med Wchnschr 1912 xxxviii  
929-932



TABLE VII—FOLLOW UP CLINIC

Hyd	1	C
At phy	4	
Go d	It	36
R	ence	
O	al p	3

fever. It was diagnosed as a hypernephroma but exploration enabled evacuation of over 60 ounces of retroperitoneal blood clot with ultimate healing. Localized hæmatomata from wound bleeding are usually not alarming although we saw one which extended suprapubically for 3 inches down along the penis enlarging this organ to thrice its normal size and into the scrotum where its size demanded evacuation. Scrotal resection for superficial varices in addition to varicocelectomy with suspension in two cases was followed by scrotal hæmatoma one case requiring evacuation of the clots. Scrotal resection is rarely if ever indicated.

Infection often follows bleeding. Deep infection usually associated with hæmatoma followed operation in 34 of our cases. One wisely avoided handling the skin in performing varicocelectomy as it is practically impossible to sterilize the skin of the scrotum and lower groin.

Postoperative induration is frequently noted but nice attention to hæmostasis will obviate most of this. Skillern (6) advised an operation said to eliminate induration—a complete resection of the anterior veins from the internal inguinal ring to the testicle without disturbing the vas in its bed.

Acute epididymitis followed operation in 7 days in 1 case. Subacute epididymitis developed in 4 others. Once the unidentified vas was accidentally cut but it was immediately sutured. Venous thrombosis was noted once. In a case of Keyes (15) several surgeons failed to make the diagnosis of pampiniform plexus thrombosis because never having felt such a thing before they were unwilling to permit their fingers to make the diagnosis. Removal of the clotted veins was followed by good result.

Testicular pain was complained of by 3 of the 42 follow up cases. In one a suspensory brought relief in another the discomfort was noted in hot weather only. Of patients followed by Barney (7) 30 per cent still had pain 27 per cent had a sex neuritis and 15 per cent suffered a recurrence. In

our series reoperation was performed in 9 cases originally operated on elsewhere. We are not aware of a recurrence but if we were able to follow more of our patients probably many more complications and undesirable sequelæ could be recorded. However this operative procedure as used at

Bellevue has proved far superior to other methods more commonly employed and because it does uniformly relieve testicular pain and drainage which are the chief symptoms of varicocele we believe it to be the technique of choice.

## SUMMARY

The etiology of varicocele is not clear but in most cases varicocele is associated with chronic genital congestion induced by faulty sexual hygiene. Of the 500 cases here reported 9 of every 10 were between 15 and 35 years of age. Advancing years or marriage symptomatically cure most varicoceles. The right side is but rarely involved. If the lesion is large and of long standing testicular atrophy is frequently observed. The bearing of worms feeling elicited on palpation of the pampiniform plexus establishes the diagnosis. Clinically and therapeutically three types of varicocele are recognized: (1) asymptomatic varicocele of which the patient is unaware. These are best left alone. (2) Moderate or large sized varicocele. Its presence is denoted anatomically by scrotal enlargement and symptomatically by a feeling of weight pain or a dragging sensation either in the testicle or referred to the cord groin or loin. Operation benefits these cases. (3) Small varicocele which causes symptoms disproportionate to the objective finding. Most varicoceles are of this type. The patients are broadly grouped as sexual neurasthenics. They are best treated by the institution of common sense sexual and physical hygiene. A scrotal suspensory will relieve many. In this type of patient operation is usually unsatisfactory as the symptoms persist after operation.

The suspension operation devised by Vincent on the Urological Service at Bellevue Hospital is the procedure of choice because it uniformly relieves pain and testicle drag and postoperative sequelæ are minimal. Hydrocele and atrophy of the testicle are the most frequent postoperative complications. Hæmorrhage from the spermatic vessel may be most serious. It should be remembered that the tunica vaginalis may be injured without presenting itself in the operative field and care to operate high on the cord with a minimum of manipulation will do much to diminish the incidence of postvaricocelectomy hydrocele. Atrophy follows operation in a moderate number of cases. Employment of transfixion suture about the resected spermatic cord vessels will eliminate severe hæmorrhage. After operation testicular support is very essential for at least 10 days. The patient is usually confined to bed only for from 5 to 7 days.

## BIBLIOGRAPHY

- 1 AMOROSI P Radical cure of varicocele with orchiopey *Policlin sez prat* 192 xxix 1621-165
- 2 BARNEY J D Varicocele an analysis of 403 cases *Pub Massachusetts Gen Hosp* 1910 iii 335
- 3 BILLROTH Quoted by White and Martin *Cenito Urinary Surgery Philadelphia J B Lippincott Co* 1918 397
- 4 BLOODGOOD J C Warning against operation for varicocele on applicants for enlistment registrants for selective draft and soldiers *J Tennessee M Ass* 1918 x 469
- 5 CAMPBELL M F Treatment of acute epididymitis *Ann Surg* 1907 lxxxvi 577-590
- 6 COLLINGS C W Scrotal bandages *J Urol* 1922 vii
- 7 CORNER Ligation of the spermatic artery in the operation for varicocele *Lancet* 1911 ii 1094
- 8 DOUGLAS JOHN Results of varicocele operation *J Am M Ass* 1921 lxxvi 16
- 9 LACE C H Retroperitoneal hæmatoma after radical cure of inguinal hernia and varicocele *Brit J Surg* 1920 vii 542
- 10 FIORINI E Clinical and experimental contribution to treatment of varicocele *Policlin sez prat* 1924 cx i 1195-1198
- 11 FRANK E Surgical treatment of varicocele *Zentralbl f Chir* 1923 lii 43-484
- 12 ISNARDI L Operation for varicocele without injury to the spermatic cord or scrotum *Zentralbl f Chir* 1921 xlviii 1382
- 13 JACOB O Surgical treatment of varicocele *Rev de chir* 1919 lvi 352
- 14 KEYES E L *Urology New York D Appleton & Co* 1924 51
- 15 Idem Personal communication
- 16 PEPPER O H P Neglect of onset symptoms varicocele as first sign of sarcoma of kidney *Med Clin N Am* 1926 x 29-36
- 17 PRIMA C Treatment of varicocele *Zentralbl f Chir* 1923 lii 2244-245
- 18 QUENU Quoted by White and Martin *Cenito Urinary Surgery Philadelphia J B Lippincott Co* 1918 368
- 19 SANFORD H L Varicocele *Cabot's Urology Philadelphia Lea & Febiger* 1918 484
- 20 SELLERS P J JR Consideration of varicocele operation and avoidance of postoperative induration *Ann Surg* 1906 lxxii 508
- 21 TURNER P Treatment of varicocele by excision *Lancet* 1911 i 759
- 22 WHITE *Brit M J* 1914 ii 177
- 23 WOLF Erfahrung en mit der von Nil on anegehenden modifikation der Marathchen Varikozelenoperationen *Deutsche med Wchnschr* 1911 xxxviii 929-932

# EDITORIALS

## SURGERY, GYNECOLOGY AND OBSTETRICS

F A L N H M A T I N M D  
A E B K N E M D

M n g E d i t  
A t E d t o

W L L M J M A M D

C h i f f E d i t : S t f f

OCTOBER 1938

### THE CANCER CELL IN GENERAL PRACTICE

THE most outstanding conclusion at the last International Conference for the Control of Cancer was that cancer must be recognized in its earliest stages if it is to be cured by present methods. The chief function of the American Society for the Control of Cancer and an important activity of the American College of Surgeons is the education of the public and the profession in the early recognition of cancer.

The gradual average reduction each year in the size of neoplasms as they are seen in some of the larger clinics proves that popular and professional cancer campaigns are yielding the desired results. Coincidental with such reduction in size has come the increasing difficulty of differential diagnosis. Statistics show that clinicians are making a smaller percentage of positive clinical diagnoses of malignancy. These two facts—the reduction in the size of neoplasms and the increasing difficulty of diagnosis—demand professional attention and will probably be met by exploration and biopsy examination of tissue by excision if not incision of the tumor for clinical diag-

nostic purposes. This procedure will not be useful unless pathologists recognize the value and the proper method of making fresh tissue examinations. Tissues must be fresh and unfixed; they may be frozen and sectioned with a microtome or sectioned with a razor, the latter giving thicker and not as satisfactory preparations. Frozen sections should be stained with Unna's or Terry's polychrome methylene blue by immersion in the stain. Razor sections should be painted only on one side. Sections made by the latter method rapidly fade but are satisfactory if a microtome is not available. The technical method, however, is not the important part of making a diagnosis; it is merely a means of saving time. Knowledge of detail of the morphology of normal regenerative and neoplastic cells as seen with an oil immersion lens and wide experience in checking pathological against clinical data are the essential qualifications of a properly trained expert diagnostician of tissue. Fixed and embedded tissues will not serve in the cytological study of fresh tissue. Malignant cells have definite morphological and volumetric characteristics which distinguish them from adult and regenerating cells. These characteristics can be seen only in the fresh unfixed condition with an oil lens. The old histological criterion—the penetration of the basement membrane—does not represent the earliest stage of malignancy although it might be the arbitrary criterion for naming a lesion cancer. Malignant cells actually exist before the invasion of tissues and although they may not be called cancerous they are indistinguishable morphologically from cells which all pathologists call cancerous. These

cells are seen in the tubules and frequently outside the tubules in the breast in borders of chronic gastric ulcers and in the uterus. In the absence of any specific serological test or skin reaction for cancer the presence of these cells is the best means of making early diagnosis. Their presence as an index for radical or extensive removal of an organ or the tissue containing them is more conservative and more definite than the past clinical criterion.

If therefore patients are to be urged to take early heed of all lesions and to submit to exploration and biopsy we must be prepared to recognize these early changes in cytology. Pathologists must become familiar with fresh tissues and be prepared to render immediate service to surgeons so that the patient may have the benefit during the operation of early biopsy reports. It is only in this manner that the medical profession can properly react to the public's response to cancer propaganda centered around early diagnosis.

WILLIAM CARPENTER MACCARTY

## A CLINICAL APPRAISAL OF CHOLECYSTOGRAPHY

CHOLECYSTOGRAPHY represents a distinct contribution to medicine for which the profession is greatly indebted to Graham and his co-workers. It is undoubtedly the best existing single laboratory test and promises to be as extensively utilized in the diagnosis of cholecystic disease as roentgenoscopy in diseases of the upper digestive tract. The method moreover has been an indispensable procedure in present day research directed to the function of the gall bladder particularly to the mechanism of its emptying concerning which there has been much disagreement. Both clinician and surgeon have welcomed its

advent as they appreciate the superiority of visualizing methods of diagnosis. However, there are certain definite limitations to the method of which both physician and surgeon should be cognizant. Previous reports without exception have been misleading in that diagnostic efficiency has been estimated largely on the basis of a group of cases in which the gall bladder was removed because of a diagnosis of cholecystic disease from the cholecystogram. Diagnostic accuracy as high as 98 per cent has been claimed. The actual diagnostic value of the method can be determined only by a consideration of its limitations and possibilities for error at the same time. Before discussing these limitations it seems reasonable to assume that further progress is possible in this field only after the adoption of a common standard of what constitutes adequate gross and microscopic evidence of cholecystic disease. It also seems reasonable to maintain that meticulous examination of a gall bladder may disclose departures from the normal resulting at times from a former transient and resolved inflammatory process which may have left the viscus able to function normally and not give rise to untoward symptoms. Pathological criteria can be made so conveniently elastic that any slight departure from the normal could be made the excuse for removing the gall bladder when the operation was undertaken on the basis of a mistaken cholecystographic diagnosis.

Certain facts become readily apparent to those who have had wide experience with cholecystography. First cases that afforded definite clinical evidence of cholecystic disease chiefly of calculous cholecystitis, hydrops, empyema, acute subacute and gangrenous cholecystitis and obstruction of the cystic duct also invariably afforded positive evidence of disease in the cholecystogram.

Second the clinical history and physical examination after exclusion of the stomach and duodenum as the site of disease in many instances enabled the clinician to make a diagnosis of definite cholecystic disease verified at operation in a little more than 90 per cent. In this group cholecystographic examination would have been superfluous except for scientific reasons. Finally the high degree of cholecystographic accuracy in cases verified surgically was probably more apparent than real. Such cases were really sifted out by the clinician. In other words with the exception of a small group of clinically indefinite cases or those in which symptoms were mild with evidence of calculi in the cholecystogram clinical criteria rather than cholecystography furnished the basis for diagnosis and operation.

The limitations of the method are brought about by various factors such as variation in the response to the test in normal and pathological cases on repeated examination various sources of error both in technique and interpretation and frequent positive cholecystographic evidence of disease in which there is absence or insufficient clinical evidence of it. Positive errors are especially seen in two clinical types of cases: the asthenic visceroprotic nervous patient with gastric subacidity or anacidity often associated with a lowered basal metabolic rate and the patient with hyperacidity from whatever cause and especially one with duodenal ulcer. On the basis of a large series 41 per cent of the proved positive errors occurred in patients with duodenal ulcer in whom the gall bladder was found objectively normal at operation. What is more important there is a considerable number of cases in which cholecystographic data are negative and in which definite symptoms and signs of cholelithic disease are verified at operation in

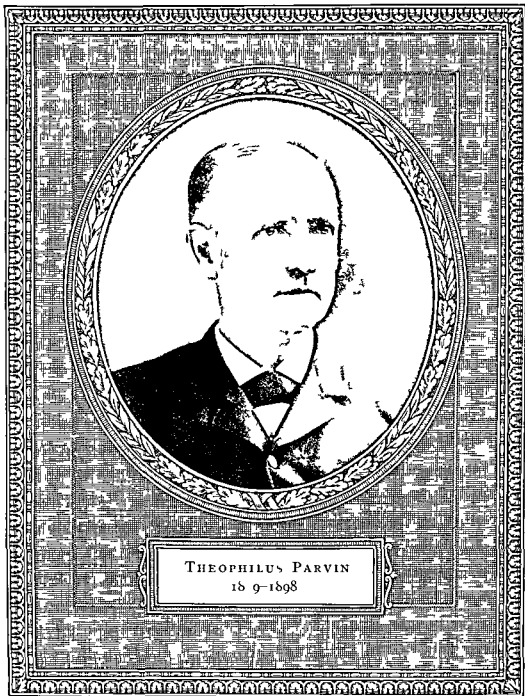
fact false negatives range as high as 25 to 30 per cent. This important feature has not been sufficiently stressed in the literature. The silhouette of the thickened diseased gall bladder itself may simulate the appearance of the dye filled viscus thus misleading the inexperienced clinician and surgeon. In a sense this is a negative error. A false negative response is highly possible in a gall bladder containing pure cholesterol or cholesterol rich stones which are often found in normal appearing thin walled gall bladders therefore causing little change in the concentrating activity of the organ. Such stones comprise almost 20 per cent of the total and negative responses are often seen although the history may be typical of hepatic colic.

It is reasonable to infer that the intravenous mode of administration of the dye is the more reliable. Whether it is sufficiently superior to replace the oral method which is far more convenient to administer and less uncomfortable to the patient has not as yet been determined. Both methods have their enthusiastic proponents. Undoubtedly under certain circumstances especially in cases with anacidity and hyperacidity a repetition of the test by the intravenous method in doubtful cases is indicated. Ordinarily a repetition of the oral method should suffice. Champions of the intravenous method should remember however that the negative cholecystographic response is the least reliable of all signs and the silhouette is intensified by this method.

Cholecystography is essentially a test of function and not of disease a fact recently conceded by Graham. The identification of the stones as shown by negative shadows is the chief exception. At the present stage of development cholecystography should not be relied on to the exclusion of other data to affirm or reject the presence of a diseased gall bladder.

GEORGE B. EUSTERMANN





THEOPHILUS PARVIN

189-1898

# MASTER SURGEONS OF AMERICA

## THEOPHILUS PARVIN

**T**HEOPHILUS PARVIN probably the most classical philosophical contributor to the literature of obstetrics and gynecology America has ever known was born in March 1829 at Buenos Aires Argentina where his father the Rev. Theophilus Parvin was stationed as a missionary. His mother was the daughter of Cesar Augustus Rodney attorney general of the United States under President Jefferson. She died when he was two weeks old and his father brought the child back to this country. The father died however when young Theophilus was 7.

Parvin entered LaFayette College at 12 and finished his academy career in the University of Indiana in 1847. He studied Greek and Hebrew at Princeton received his master's degree in 1850 at the age of 21 and the degree of doctor of medicine from the University of Pennsylvania in 1852. For 2 years he shipped as surgeon on a line of packets between Philadelphia and Liverpool. He filled successively the chairs of materia medica at Ohio Medical College 1854 to 1864 of obstetrics and diseases of women in the University of Louisville where he remained until 1869 of obstetrics and diseases of women at Jefferson Medical College Philadelphia from 1883 until his death in 1898. Dr. Parvin showed his versatility in accepting the post of house surgeon of Wills Eye and Ear Hospital in Philadelphia immediately upon his graduation.

His writings attracted attention and he was besieged with offers of editorship of medical journals. In conjunction with Roberts Bartholow who was with him on the faculty of Ohio Medical College at Cincinnati Parvin edited the *Cincinnati Journal of Medicine* which is now in charge of Dr. Charles L. Bomfield. In 1866-7 and in 1868-9 he edited the *Western Journal of Medicine* with David Vandell of the University of Louisville he was co editor of the *American Practitioner* 1869-1883.

In going through the bibliography of the latter third of the 19th century one is struck with the myriad of his contributions and the great variety of subjects upon which Parvin wrote always with a style most entertaining and illuminating. His textbook *The Science and Art of Obstetrics* which ran rapidly through several editions was marked by its accuracy and erudition and as well by the abundance of classical and modern references with which it abounded.



He translated von Winckel's *Diseases of Women* from the German was a contributor to Ashhurst's *Encyclopaedia of Surgery* Sajous' *Universal Medical Sciences* the *American Textbook of Obstetrics* and the *American Textbook of Therapeutics*

He was successively elected president of the State Medical Society of Indiana the American Medical Association and the American Academy of Medicine he was one of the founders and an early president of the American Medical Editors Association and he was a founder and president of the American Gynecological Society the Philadelphia Obstetrical Society and various other medical organizations

In 1891 he presided at the International Congress of Obstetrics in Brussels In 1890 I first met him while he was chairman of the obstetrical section of the tenth International Medical Congress at Berlin where he was associated with Koch Esmarch Hlaváček and Pasteur on a most notable series of programs A long list of honorary fellowships in foreign societies is attached to his name The preserved contribution to the then current medical literature comprises over one hundred and fifty titles but these do not include all his writings He must be classed as one of the great men who have illumined the medical profession with their intellectual attainments His vigorous well chosen English was a delight His clinical illustrations were always apt In fact he was the embodiment of the erudition which pervaded all his writings through the thirty years (1868-1898) of his active professional and teaching career

Dr William H Parrish who wrote his obituary for the American Medical Association said Theophilus Parvin's career as the master obstetrician of America is familiar to the medical profession During the last quarter of the 19th century he ranked undoubtedly among the greatest living authorities in medicine

His textbook on obstetrics was received enthusiastically by students and physicians alike and occupied the relative position in obstetrics that Samuel D Gross monumental work did in surgery that Sir Thomas Watson and Trousseau did in medicine and Roberts Bartholow's *Materia Medica* did in therapeutics

In 1889 Dr Parvin established the first obstetrical clinic in America following the method of von Winckel in Munich 34 cases were delivered without a maternal death In making a report of this enterprise before the New York Academy of Medicine Parvin appealed to that organization to set the light to guide the profession making clinical obstetrics a part of the curriculum of the medical school of the country He urged that every college which refused to take this step should be criticized by common condign condemnation

Three philosophical essays of Parvin have come down to us in which a third of a century ago he analyzed problems which are today of peculiar interest

These were on 'The Genius of Medicine' "The Woman and her Physician," and 'The Casuistry of Medicine'. The first was based on Conte's definition of a science as 'Knowledge which enables us to foresee and foretell events'. He said in substance: Let any case of common disease be examined by half a dozen educated physicians and there would be in almost every instance an exact agreement as to the nature of malady, its progress and the means advisable to eliminate it or to shorten its course. The natural history of disease is so like an open book to the trained physician that he can in the majority of cases foresee and foretell it.

Parvin said that the student must not forget that the foundations of our science were laid by Hippocrates the noble Greek and that it came not from the temple nor the gymnasium but from the laboratory of the physician.

In his oration on Woman Parvin says: Beauty is the common physical characteristic of woman; age, disease, poverty, suffering, ignorance, the play of evil passions may mar or destroy the beauty, not in a single individual only, but in those deriving their origin from her. Nevertheless this gracious gift is the general possession of the sex.

To show the remarkable impression Dr. Parvin made on his auditors by the flight of his poetic tribute to the power of the beauty in woman, I will quote the following incident: I was astonished while speaking of his life before the Louisville Obstetrical Society in February 1927 to hear Dr. William B. Doherty, now 85 years of age, who was on the Faculty as an instructor when Parvin taught in the University of Louisville, repeat from memory the quotation from the twenty-fourth ode of Anacreon the Greek poet wherein he spoke of the gifts of nature to all that breathe the air of heaven: some boon-wreathed horns to the bull, the hoof of strength to the steed, speed to the timid hare. Then this apostrophe to woman:

To man she gave in that proud hour  
The boon of intellectual power  
Then what O woman! what for thee  
Was left in Nature's Treasury?  
She gave thee beauty—mightier far  
Than all the pomp and power of war  
Nor steel nor fire itself hath power  
Like woman in her conquering hour  
So be but fair, mankind adores thee  
Smile, and a world is weak before thee!

The motive of Parvin in this address on woman was to emphasize the peculiar type of relation between the sexes and the delicacy needed in the practice of gynecology and obstetrics as contrasted with other departments of medicine.

His greatest effort was in the essay 'The Casuistry of Medicine' in which he showed the problem which dominated all philosophy, all science and its applica-

tion to art not only in the ordinary relations of life but to us specifically through the evolution in medicine from that of Æsculapius and Hippocrates down to our own myriad of specialties—the problem of right and wrong in a debatable decision. Of course Parvin used the definition of casuistry as in its original application by the Jesuits in solving the questions of conscience—the interpretation of ethical principles to questions of conscience and judgment. He discussed many questions which today are still matters of controversy: birth control, the induction of abortion where he quotes *Lex lex dura sed lex*—the right of the mother against the child if either is to be sacrificed—the question of which phase of prevarication constitutes lying in medicine which I remember Furchild of Oberlin College decided in his day and Joseph Collins in ours has elucidated. Many other points will appeal to every surgeon interested in medical history because as far as said casuistry is just as much to be applied to reasoning, judgment and philosophy today as it was in the beginning of history.

Dr. Parvin is survived by a son Dr. Noble Parvin and a daughter Mrs. James P. Baker, both living in Indianapolis. To them as well as to the successors in the chair he graced in the various medical schools I am indebted for much of the personal data of this tribute to one of my ideals—Theophilus Parvin.

GEORGE CLARK MOSHER



LA GRANDE  
CHIRVRGIE  
DE M GVI DE  
CHAVLIAC, MEDE-

CIN TRES-FAMEVX DE  
l'Vniuersite de Mompelier,  
composee l'an de grace  
M CCC LXIII

RESTITVEE NOUUELLEMENT  
A SA DIGNITE,

Pa M LAURENS IOBERT Medecin ordinaire du Roy  
& du Roy de Navarre, premier Docteur regent Espridre, Chan-  
cellier & Inge de ladite Vniuersite

Voyez au prochain feuillet ce que M IOBERT ha fait  
(oultre sa nouvelle traduction) & fourny d'ancien  
en recognoissant cest œuu e



A LYON  
PAR ESTIENNE MICHEL  
M D LXXIX

*Avec priuilege du Roy.*

# THE SURGEON'S LIBRARY

## OLD MASTLRPIECES IN SURGERY

By ALFRED BROWN, M.D., F.A.C.S., OMAHA

### THE GREAT SURGERY OF GUY DE CHAULIAC

GUY DE CHAULIAC came into a world which was actively undergoing a period of reconstruction in all its intellectual and economic phases. The crusades were only thirty years past at the supposed time of his birth (1300) and the lessons which they taught were being absorbed and were causing a readjustment in the mental concept of the relation of the individual to life and its responsibilities. The dark pall cast by blind faith in the dictates of medieval mystical monasticism was being rent asunder and the light of reason and learning gained from the pagan Saracen was peeping through to give the European a sight of the advantages of study and education on the one hand and of international trade through amicable commercial relations on the other. This change had been going on gradually during the centuries of the crusades but it was not until the actual fighting ceased that the change in the psychological reactions of the people was fully appreciated. Nevertheless the armamentarium so to speak which future generations were to use to their great advantage had been prepared. The Universities at Salerno, Padua, Bologna, Paris, Montpellier and Oxford had been founded and the learning of the Ancient Greeks and the Arabian School was there to be taken advantage of by him who wished. In addition to these general world conditions Guy de Chauliac had the opportunity of carrying on the work of two great surgeons of his own country. Jean Itard (died circa 1328) who had founded the Collège de St. Come and Henri de Mondeville (died circa 1320) who had been the famous professor of surgery at Montpellier.

Guy de Chauliac was born in the little hamlet of Chauliac about 1300. He received his first instruction in medicine at Toulouse and then traveled around Europe to the various medical centers to increase his knowledge and experience. His wanderings carried him to Montpellier, Bologna and Paris and possibly to Prague and at the end of this period having become grounded in medicine he considered himself equipped to take up the study and practice of surgery. In this he followed the dictates of his predecessor Henri de Mondeville and expressed his belief when he discusses the qualifications of the surgeon and laid down as one of these qualifications. It is thus requisite in the first place that the surgeon be learned not only in the prin-

ciples of surgery but also in those of medicine both in the theory and in the practice. He also stresses the necessity for a knowledge of anatomy and was for his time an excellent anatomist.

Guy's principal work was his *Great Surgery* so called because he is supposed to have written a *Little Surgery* but doubt has been cast upon his authorship of the latter and it has been attributed to another author. The *Great Surgery* was written when he was over sixty years of age and with the desire to pass his knowledge of the Surgery of the ancients and the results of his own experience on to others. He was then physician and canon to Pope Urban V as he had been to his predecessors Clement VI and Innocent VI. He says he is writing the work also. Partly for myself as a solace in my old age and to exercise my mind and to you Messieurs the physicians of Montpellier, Bologna, Paris and Avignon principally those of the Popes who have been my companions in the service of the Roman Pontiffs with whom I have been sustained in guarding against mediocrity by listening, reading and operating. I will state with a moderate abbreviation the principal things that the sages and wise men have spoken or written in many volumes of books on surgery. Wherefore this book will be called the inventory or collection of Surgery.

Guy succeeded so well in his task that his work became the standard reference work and textbook in surgery for centuries and he was called the father of modern surgery. His knowledge of his subject was marvelous and his ability to express this knowledge in clear and lucid style was unsurpassed though in actual contents the book is just what he tried to make it a review of the best there was in surgery. Passed on in manuscript form for over a century it was first printed in 1478 and from then on until the seventeenth century.

In 1579 Laurent Joubert, Chancellor of the University of Montpellier, published the best French edition of Guy's surgery up to that time. Joubert consulted all the printed editions and many of the manuscripts and after many years study produced the volume the title page of which is shown. It was printed at Lyon by Michel Estienne at the Stephanus Press following the then beginning custom of printing medical books in the vernacular. Joubert however edited a Latin edition which was printed at Leyden six years later.

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ciples of surgery but also in those of medicine both in the theory and in the practice. He also stresses the necessity for a knowledge of anatomy and was for his time an excellent anatomist.

Guy's principal work was his *Great Surgery*, so called because he is supposed to have written a *Little Surgery*, but doubt has been cast upon his authorship of the latter and it has been attributed to another author. The *Great Surgery* was written when he was over sixty years of age and with the desire to pass his knowledge of the Surgery of the ancients and the results of his own experience on to others. He was then physician and canon to Pope Urban V as he had been to his predecessors Clement VI and Innocent VI. He says he is writing the work also. Partly for myself as a solace in my old age and to exercise my mind and to you Messieurs the physicians of Montpellier, Bologna, Paris and Avignon, principally those of the Popes who have been my companions in the service of the Roman Pontiffs with whom I have been sustained in guarding against mediocrity by listening, reading and operating. I will state with a moderate abbreviation the principal things that the sages and wise men have spoken or written in many volumes of books on surgery. Wherefore this book will be called the inventory or collection of Surgery.

Guy succeeded so well in his task that his work became the standard reference work and textbook in surgery for centuries and he was called the father of modern surgery. His knowledge of his subject was marvelous and his ability to express this knowledge in clear and lucid style was unsurpassed though in actual contents the book is just what he tried to make it a review of the best there was in surgery. Passed on in manuscript form for over a century it was first printed in 1478 and from then on until the seventeenth century.

In 1579 Laurent Joubert, Chancellor of the University of Montpellier, published the best French edition of Guy's surgery up to that time. Joubert consulted all the printed editions and many of the manuscripts and after many years' study produced the volume the title page of which is shown. It was printed at Lyon by Michel Estienne at the Stephanus Press following the then beginning custom of printing medical books in the vernacular. Joubert however edited a Latin edition which was printed at Leyden six years later.





Volumes V and VI. The high standard set by the first four volumes of Nelson's Loose Leaf Surgery is maintained in Volumes V and VI which have just been issued. Volume V which is devoted to abdominal surgery is incomplete, the papers of Professor Alessandri of Rome on the Surgery of the Liver and of Professor Ochsner of Fulane on Surgery of the Intestines are absent but may readily be inserted in the loose leaf binder when supplied.

The very valuable chapter on Peritonitis is by Joseph A. Blake.

A. J. Walton of London, England has contributed 120 pages on the Surgery of the Stomach and Duodenum.

Vernon C. David has furnished the Surgery of the Rectum and Anus with the exception of Malignant Disease of the Rectum which is by Daniel F. Jones.

The chapter on Appendicitis is by Roger T. Vaughan and Eugene H. Pool and Ralph Stillman are the authors of the excellent section on the Surgery of the Spleen.

The Surgery of the Pancreas is by John Spence. The Editor in Chief Professor Allen O. Whipple has chosen for his subject the Surgery of the Biliary System and has made it a most complete and valuable chapter.

Volume VI is devoted entirely to the subject of urology and many of the country's most eminent urologists have combined to make it an extremely valuable text of that subject. The surgery of the urethra and penis and of the scrotum, testicles and groin are by Franklin P. Johnson and Francis R. Hagner respectively.

Hugh H. Young has contributed the chapter on the Surgery of the Prostate which includes a section on Suprapubic Prostatectomy by Alexander Randall. William C. Quinby has written the Surgery of the Seminal Vesicles and William R. Frantz that of the Bladder with the exception of Congenital Anomalies, Tumors and Diverticulum which is by J. A. C. Cotson.

The chapter on Renal Structure and Function is by Frank Hinman and that on Nephrolithiasis by H. A. Fowler.

The volume is concluded by chapters on Tuberculosis and New Growths of the Kidney by David M. Davis on Cystoscopy and Urethroscopy by A. R. Stevens and on Laboratory Urology and Experimental Work by Edwin Davis.

The mechanical details of the loose leaf feature already familiar to many through Nelson's Loose Leaf Medicine are excellent. The binding covers are strong and rigid yet readily permit opening and reading of the volumes. The extra pages may be quickly and securely placed in the binder. Genuine Morocco binding enhances the appearance. The price charged subscribers for the renewal pages includes membership in Nelson's Research Service Bureau which will supply when requested without further charge special information upon any surgical subject.

The reviewer considers the six volumes of Nelson's Loose Leaf Surgery here reviewed to be an extremely valuable addition to the surgeon's reference library. The contributors are authoritative and the articles are well written. The editors and publishers may be congratulated upon accomplishing so successfully their aims namely the presentation of a Surgery of Today.

FREDERICK CHRISTOPHER

SIR WARING'S *Manual* is written in the usual form of single volume books on operative surgery, an introductory chapter on surgical technique is followed by chapters on regional surgery—surgery of the stomach and intestines, repair of hernia, surgery of the biliary system, spleen and pancreas, urologic and gynecologic surgery, etc. There are also chapters on otolaryngology and on ophthalmic operations. The volume is arranged in a systematic manner and is compact. While the various subjects are necessarily only briefly covered, the work is encyclopedic in its scope and is a valuable desk reference work for practitioners as well as students.

J. R. BUCHBINDER

MALIGNANT disease, the curse of the human race is ever confronting the medical profession. The general practitioner in some remote part of the world is no less interested than the cancer specialist in the large medical center. Whatever information that is of practical value which is and can be assembled in usable form is of value to humanity, only so far as it can be put into the hands of the physician who must treat the afflicted ones. Such a publication of value is Sir Waring's *Surgical Treatment of Malignant Disease*. The author's original idea of the treatment of malignant disease was briefly expressed in his Bradshaw lecture in 1911. This led to an analysis of the cases treated at St. Bartholomew's hospital and the collection of a large amount of data from the clinics the world over. In this Oxford monograph the author presents an assembly of these facts in a classified description of malignant disease from a clinical and surgical aspect, the pathological view being considered only insofar as it has a bearing on diagnosis and treatment. Every phase of malignant disease of the body is covered in some instances in an excellent manner, in others in a less graphic and questionable way. The discussion on malignant disease of the tongue, mouth, pharynx and larynx is unusually complete. The use of barium sulphate in the bladder as a contrast media for the study of carcinoma must be seriously questioned especially since sodium iodide or bromide has yielded such positive results in the study of the urinary tract. A careful reading of the chapters on malignant disease of the bones will show that the author considers sarcoma a disease which offers a poor prognosis yet a less careful study by one not familiar

M B L O A N E S G B S H B t J W e M S  
M B L O A N E S G B S H B t J W e M S  
F 9  
T E S M L I E T M T M I A N D S S E B S H B t  
J W e M S M B B S (L d) F R C S w l k J L O f  
H m p g M L d O u d U t y P R S 9 8

with the subject might convey the opposite impression as the author frequently refers to exceptional cures. More information on the diagnosis of bone sarcoma would be of distinct value.

Many chapters can be praised and not a few criticized for lack of specific detail and possible difference of opinion. Yet here is a book of some 700 pages devoted to the common subject of malignant disease from a clinical viewpoint. A large number of statistics are included. It offers the reader in a concise form without frills an enormous amount of information regarding the treatment of malignant disease. No work can be complete and differences of opinion—purely constructive criticism—must always obtain. The references at the close of each chapter are abundant and add distinctly to the value of the work. What it is, an assembly of a large amount of valuable information tempered by the knowledge of a surgeon of unusual experience. J. A. WOLFE

THE conservative surgeon is giving more and more consideration to anesthesia as its choice individual application and effect. As a result we find a record of far fewer postoperative complications not to mention a lower mortality rate. The selection of an anesthetic should be dependent upon the type of patient and his ability to bear a contemplated operation. The available technical ability and facilities should also be considered. The selection of the anesthetic should by no means be based upon the dogmatic determination of the surgeon to choose either a local or general anesthesia as a routine. The advocate of local anesthesia must remember that in not few cases a well administered nitrous oxide gas mixture or ethylene anesthesia may be best for his patient while the average surgeon who uses only general anesthesia could profitably employ local anesthesia in an increasingly large number of selected cases. No doubt one of the potent factors hindering this lack of knowledge as to the value of local anesthesia is the result of the complex and various methods in which local anesthesia is presented to the surgical profession and of the lack of systematic teaching of the subject to the undergraduate student.

In his recent monograph de Takats endeavors to coöperate in a rather brief and didactic manner the general principles of local anesthesia as he is teaching the subject to the undergraduate and postgraduate medical student. He states in the preface: "The student

should feel that local anesthetic methods are a part of his surgical training and that he can acquire these without the difficulty of working himself into a complicated new field—a new specialty. This is not a specialty; it is an improvement of surgical technique which is open and accessible to every prospective and active surgeon and which will bring gratifying results in his morbidity and mortality statistics."

The author makes no claim to originality but presents to the reader in a concise manner the fundamental principles upon which the technique is dependent. Many illustrations clarify and amplify the text. It is pleasing to note that specific contraindications to local anesthesia are frequently mentioned.

The reviewer is personally acquainted with the author's scheme of teaching the subject as well as with the usual technique employed in many types of individual application. There can be no question but that the portrayal in this small text is accurate and well within the scope of the average graduate or even under graduate student's comprehension. The surgeon will find it a brief and satisfactory text that will bring to his attention the essential and salient points of local anesthesia. J. A. WOLFE

THE WRIGHTS little book on appendicitis written for the lay public is really remarkable in that it presents a very complicated subject in such a clear and forceful manner. It contains a concise review of the anatomy without making the subject burdensome. It analyzes the etiology and symptoms in such a way that the reader does not get the impression that he has appendicitis or is not led to have an undue terror of the disease. It especially emphasizes the fact that discomfort and occasional pain in the right lower quadrant are not necessarily caused by the appendix.

In his outline of treatment it seems to me that Dr. Wright has emphasized the most important details: the dangers of cathartics, the dangers of delay and the inability of any surgeon or medical man to state what will happen in the course of the disease. He especially emphasizes the fact that the patient does not die as a result of the operation but in spite of it.

On the whole I consider this book a very fine presentation of the subject of appendicitis; it may be read with benefit by the medical profession and will be of great value to the lay public.

W. R. COLLINS

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# CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

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## COMPLETE PROGRAM FOR THE 1928 CLINICAL CONGRESS IN BOSTON

THE surgeons of Boston have prepared and will present a highly attractive program of clinics and demonstrations in the hospitals and medical schools of that city during the eighteenth annual Clinical Congress of the American College of Surgeons beginning Monday, October 8th and continuing through Friday, October 12th. The clinical program will completely represent the clinical activities of that great medical center in all departments of surgery. A schedule of clinics and demonstrations prepared by the Committee on Arrangements under the leadership of Dr. Frederic J. Cotton, Chairman, will be found in the following pages. The real clinical program of the Congress will be issued daily in the form of bulletins that will be posted at headquarters each afternoon giving a complete and accurate schedule of the clinics and demonstrations that are to be given at each of the hospitals on the following day. Printed programs will be distributed each morning.

For those whose practice is confined to ophthalmology and otolaryngology the Committee has prepared in addition to clinics and demonstrations during the morning hours of each day a series of clinical demonstrations and conferences on Tuesday, Thursday and Friday afternoons to be presented in the Georgian Room at the Statler Hotel. The program for these sessions will be found in the following pages. On Wednesday

day afternoon in the same room a symposium dealing with the principles involved in the standardization of eye, ear, nose and throat departments in general hospitals will be presented.

General headquarters for the Clinical Congress will be established at the Statler Hotel where the ballroom, foyer and other large rooms on the mezzanine floor have been reserved and will be used for registration and ticket bureaus, bulletin boards, technical exhibition, executive offices, etc. Headquarters will be open for registration at 8 o'clock on Monday morning, October 8th. The ballroom at the Copley Plaza Hotel will be utilized for evening meetings, hospital conferences, the annual meeting and other large gatherings.

A special feature of this year's meeting will be the showing of several surgical films that have been produced under the supervision of and approved by the American College of Surgeons. A number of such films will be given their premier showing at Boston. In addition it is planned to show a number of surgical films that have been made in England and France.

A feature of the Boston meeting that will be of interest to all surgeons will be the celebration of Ether Day at the Massachusetts General Hospital on Friday. Exercises will be held at 11 o'clock in the dome room of the old building, of the hospital where ether was first administered.

for the production of surgical anaesthesia on October 16 1846 On this occasion a bronze bust of William T G Morton will be presented to the hospital

In addition to those surgeons from abroad whose names appear in the program for the evening meetings there will be present at this year's Congress a number of distinguished surgeons from various parts of the world including Sir George A Syme of Melbourne Australia President of the Australasian College of Surgeons George E Waugh Thomas P Dunhill and Percy T Hughes of London F n land T de Martel of Paris France Charles G I Morice of Wellington New Zealand Farquhar Macrae of Glasgow Scotland Daniel J Cranwell of Buenos Aires Argentina Louis L Cassidy and Charles J MacAuley of Dublin Ireland Ulises Valdes and Rafael Reygadas of Mexico City Mexico

#### EVENING MEETINGS

The general program prepared by the executive committee includes evening sessions on each of the five days of the Congress The complete program for these evening sessions will be found in the following pages The Residential Meeting on Monday evening in the Convention on Friday evening are to be held in Symphony Hall On Tuesday Wednesday and Thursday evenings meetings will be held in the ballroom of the Copley Plaza Hotel At the Residential Meeting on Monday evening the President Elect Dr Franklin H Martin of Chicago will be inaugurated and will give the annual address On the same evening the Murphy Oration in Surgery will be delivered by Professor Vittorio Iutti professor of orthopedic surgery in the university at Bologna Italy and Director of the Rizzoli Institute At the Convocation on Friday evening the Fellowship Address will be delivered by Dr William J Mayo

On Wednesday evening the visiting surgeons will be guests of the Boston Surgical Society at a special session at which the Henry J Bigelow Medal is to be presented to Professor Chevalier Jackson of Philadelphia

#### OPEN FORUM AND SYMPOSIUM ON TRAUMATIC SURGERY

An open forum on traumatic surgery has been planned for Friday morning at the Copley Plaza Hotel beginning at 10 o'clock and in the afternoon at 2 o'clock a more formal presentation of the subject at which time papers will be presented without open discussion For the morning session a number of subjects have been selected and men

chosen to give five minute talks thereon following which there will be a general discussion The program for the open forum is as follows

L YAL A S OUDY MD B l l l e m P W h t R i t n  
S l l d f t b e t I l l t l M d l d p t  
m n t d t e O t h f c u t s o f t h i d t y?  
T r e d G H u l l s B i l l C W h a t t r e t l e i t i  
f t t h e P h y a l J u m t o f n i d t l  
M d c a l D p a r t m t (I l l u t r d)  
A D L a n y M D B l i m e C M d H J C F e o  
o m b e I r y d n t l C f t h I n e d  
D Y A L A G e t h i M D S y e l W h t t e t h e  
A d a t g a l M t l d o f S u p e v i o n I T u m a t  
S g y i a H p t i  
D Y A L B C R A G I N M D H t f o r d C o W h t t h e  
P l c e f P h y l f h i t h C o f t h e I j d  
E A W W I L L I S O N M D C h i a g W h a t e S o m f  
t h d e f e i n t l O g a z a t o f o r C f t h e I j r d  
S n n a l C t y

The following program for the symposium in the afternoon has been prepared

F R I A B E S L E Y M D C h a o C h r m P r o f s o  
o f S g y N t h w e t e r U r s t y M e d i c l S h o o l  
R p o t o f B a d n T r m t S g e r y  
I G S C U T T E M D C h i g o D a N o t h w t  
U r s t y M e d i c l S h l T r a m t c S u g e y  
E d t I P r o b l m  
J N P F R E Y W h t D C A m r c a n F e d t  
f L a b o T l R e l a t n o f O g n i z e d L a b o t t h e C  
f A c c d t  
L I D S A Y R o R S P h D L L D N e w Y o r k P r e s e r f  
P b l i C l m b a U t y S m e A p e c t f t h  
M d l S t a t a u d r t h e N e w Y o r k W o r k m e  
C m p t A t  
T I O T S P H E N R Y P s d e t f A m e r c a n A t m b l  
f t h M o t s t  
D Y D B E Y E R B t D r e c t o r o f N t a l S i t y  
C n l i v t n f l c d t

In connection with the meetings on Friday dealing with various aspects of traumatic surgery it is important to note that a series of clinics in industrial surgery has been prepared for each afternoon to be held in the medical department of the American Mutual Liability Insurance Company A detailed schedule of these clinics will be found in the preliminary clinical program

#### ANNUAL MEETING

The annual meeting of the Fellows of the College will be held at 2 o'clock on Thursday afternoon in the ballroom of the Copley Plaza Hotel reports of officers and standing committees will be presented and officers elected for the ensuing year

Following the annual meeting there will be presented a symposium on the Treatment of Malignant Diseases with Radium and X ray which will include a special report on the treatment of cancer of the breast The complete program for this session appears on another page

## HOSPITAL CONFERENCE

The eleventh annual hospital conference of the American College of Surgeons opens on Monday morning at 10 o'clock with a session in the ball room of the Copley Plaza Hotel. The program for the hospital conference which calls for morning and afternoon sessions in the same room on the following days and which is published complete in the following pages provides an interesting series of papers, practical demonstrations and round table conferences dealing with numerous problems related to hospital efficiency.

A special session on Wednesday afternoon will be of particular interest to those whose practice is confined to surgery of the eye, ear, nose and throat. The papers that afternoon comprise a symposium dealing with the principles involved in the standardization of such special departments in general hospitals.

During the Clinical Congress there will be a meeting of hospital record librarians to be held at the Copley Plaza Hotel. An interesting and instructive program of practical papers and demonstrations has been prepared dealing with a number of the problems associated with the maintenance of case records in the hospitals. A model record room will be on exhibition.

The hospital conference program is planned to interest not only surgeons but also hospital trustees, executives and personnel generally, and an invitation is extended to all persons who are interested in hospital activities to attend.

## SPECIAL TRAIN FROM CHICAGO

For the convenience of Fellows living in the central and western states who will attend the Boston meeting, arrangements have been made with the New York Central Lines to provide a special train leaving Chicago at 9 A.M. on Sunday, October 7th, arriving in Boston at 9 A.M. on Monday. The special train will be equipped with all steel cars of latest design, including club, compartment, observation, sleeping and dining cars. No extra fare will be charged. The train will arrive at Cleveland at 5:28 P.M., making connections there with regular trains over the Big Four from Indianapolis and Cincinnati. This arrangement is contingent upon reservations for such a special train being made by the minimum number required by the Interstate Commerce Commission rules. Fellows are urged to make their reservations for the special train at the earliest possible date, making application at the office of the assistant general passenger agent of the New York Central Lines, LaSalle Street Station, Chicago.

## REDUCED RAILWAY FARES

The railways of the United States and Canada have authorized reduced fares on account of the Boston session of the Clinical Congress so that the total fare for the round trip will be one and one half the ordinary first class one way fare. To take advantage of the reduced rates it is necessary to pay the full one way fare to Boston, procuring from the ticket agent when purchasing ticket a convention certificate which certificate is to be deposited at headquarters for the use of a special agent of the railways. Upon presentation of a valid certificate to the ticket agent in Boston not later than October 16th, a ticket for the return journey by the same route as traveled to Boston may be purchased at one half the regular one way fare.

In the eastern, central and southern states and eastern provinces of Canada, tickets may be purchased between October 4th and 10th in south western and western states between October 3d and 9th, and in the far western states and western provinces of Canada between September 30th and October 6th. The return journey from Boston must be begun not later than October 16th.

The reduction in fares does not apply to Pullman fares nor to excess fares charged for passage on certain trains. Local railroad ticket agents will supply detailed information with regard to rates, routes, etc. Stop overs on both the going and return journeys may be had within certain limits.

Full fare must be paid from starting point to Boston, and it is essential that a convention certificate be obtained from the agent from whom the ticket is purchased. These certificates are to be signed by the general manager of the Clinical Congress and visced by a special railroad agent in Boston during the meeting. No reduction in railroad fares can be secured except in compliance with the regulations outlined and within the dates specified. It is important to note that the return trip must be made by the same route as that used to Boston and that the certificate must be presented during the meeting and return ticket purchased and used not later than October 16th.

An exception to the above arrangement is to be noted in the case of persons traveling from points in the Pacific Coast states and British Columbia who will be able to purchase round trip summer excursion tickets which will be on sale up to and including September 30th with a final return limit of October 31st. The summer excursion fare is somewhat lower than the convention fare mentioned above, but is available only in the Pacific Coast states and British Columbia. Tickets sold

at summer excursion rates permit traveling to Boston via one direct route and returning via an other direct route with liberal stop over privileges

#### LIMITED ATTENDANCE—ADVANCE REGISTRATION

Attendance at the Boston session will be limited to a number that can be comfortably accommodated at the clinics the limit of attendance being based upon the result of a survey of the amphitheaters operating rooms and laboratories in the hospitals and medical schools as to their capacity for accommodating visitors Under this plan it will be necessary for those who wish to attend to register in advance

Attendance at clinics and demonstrations will be controlled by means of special clinic tickets which plan has proved an efficient means of providing for the distribution of visiting surgeons among the several clinics and insures against overcrowding the number of tickets issued for any clinic being limited to the capacity of the room assigned to that clinic

#### REGISTRATION FEE

A registration fee of \$5.00 is required of each surgeon attending the annual Clinical Congress such fee providing the funds with which to meet the expenses of the meeting To each surgeon registering in advance a formal receipt for the registration fee is issued which receipt is to be exchanged for a general admission card upon his registration at headquarters This card which is nontransferable must be presented to secure clinic tickets and admission to the evening meeting

#### BOSTON HOTELS AND THEIR RATES

Since the last Clinical Congress in Boston in 1922 a number of new hotels have been built including the Statler with 1300 guest rooms the New Parker and the Ritz Carlton Some of the older hotels have been enlarged so that there are now ample first class hotel accommodations in Boston for all who wish to attend the Clinical Congress Many of these hotels are located within short walking distance of the headquarters of the Congress

	R	M	m	m	h
	S	gl	th	B	h
	Room	Room	D	bl	Room
Belleue	B	St			
B m	464 C mm	lth l e	\$4.00	\$7.00	
Pr m k	Boyl to d Cl l St		4.00	7.00	
Pu km st	645 B St		3.5	5.00	
C t b r	4 Ch l g t W t		3.00	4.00	
Ch l gat	Ch le g te F t		4.00	5.00	
C pl y Pl	C plev S i		3.00	5.00	
Elks	75 T mo t St		4.00	7.5	
F g t	534 B St		3.50	5.00	
Gr l yn	Ch le g te West		4.00	5.00	
K m	496 C mm lth l e		3.00	5.00	
Le	E t r a d Boyl to St		3.5	6.00	
L l h e	Ch l St		3.5	4.5	
N w Pa k	T m t d School St		4.00	6.00	
P ta	39 C mm wealth l		3.5	5.5	
Ritz C lt	A l g t n a d n b y St		3.5	5.00	
Sh t	9 B y State Ro d		5.00	8.00	
Som t	400 C mm w lth l e		5.00	6.00	
Statl	I l Sq t l g t n St		3.00	5.00	
T e	Boyl to d T em t St		3.5	5.5	
Ve d m	C mm lth d Da tm tl		5.00	7.5	
Vcto a	D tm th d C mm lth		8.00	6.00	
We t m	t C pl y Sq e		4.00	6	
			3.00	5.00	

Am pl

#### CANCER SYMPOSIUM

11 sday Octob r 11—Ballroom Copley Pl a Hotel 3 30 P M

ROBERT B GREENOUGH M D Boston (Chairman of the Committee on the Treatment of Malignant Diseases with Radium and X rays) Report of the Committee

JAMES F PERCY M D Los Angeles Statistical Report of Caustery Surgery in Uterine Cancer

GEORGE GRAY WARD M D New York Radium Therapy in Carcinoma of the Cervix Uteri

WALTER E SISTRUNK M D ROCHESTER M n Criteria of Malignancy in Cancer of the Breast

GEORGE W HOLMES M D Boston Results of X ray Treatment in Cases of Cancer of the Breast

## PROGRAM FOR EVENING MEETINGS

*Presidential Meeting Monday October 5—Symphony Hall 8 15 P M*

Address of Welcome IRENERIC J. COTTON M.D. Boston Chairman of Committee on Arrangements

Address of Retiring President GEORGE DAVID STEWART M.D. New York

Introduction of Foreign Guests

Inaugural Address The Evolution of Clinical Medicine and Surgery in Relation to the Preservation of Health and Life FRANKLIN H. MARTIN M.D. Chicago

The John B. Murphy Oration in Surgery Malignant Bone Tumors PROFESSOR VITTORIO PUTTI Bologna Italy

*Tuesday October 6—Ballroom Copley Place Hotel 8 15 P M*

Hunterian Oration Grand Curiosity SIR SQUIRE STRATGER M.D. B.Ch. I.R.C.S. London

Symposium Ureteral Transplantation

ROBERT C. COFFIN M.D. Portland Oregon Transplantation of Ureters into the Large Bowel

CHARLES M. MCKENNA M.D. Chicago Ind Results in Transplantation of Ureters

ARTHUR H. CURTIS M.D. Chicago Notes on (1) Management of Ureteral Injuries (2) Surgical Indications in Patients Who Require Ureteral Transplants

CHARLES H. MAYO M.D. Rochester Minn. Contributing Causes of Genito Urinary Anomalies

Discussion GEORGE GIBBERT SMITH M.D. and WILLIAM CARTER QUINBY M.D. Boston

*Wednesday October 10—Ballroom Copley Place Hotel 8 30 P M*

Special Meeting of the Boston Surgical Society Presentation of the Henry J. Bigelow Medal

CHEVALIER JACKSON M.D. Philadelphia Bronchoscopy—Past Present and Future

*Thursday October 11—Ballroom Copley Place Hotel 8 15 P M*

PROFESSOR ARCHIBALD YOUNG M.B. (M.F.R.F.S.) Glasgow Sacrococcygeal Chordoma

SIR CHARLES BALLANTYNE K.C.M.G. C.B. M.O. London Some Thoughts on the Nature of Cancer

GEORGE W. CRILEY M.D. Cleveland The Adrenal Factor in Hyperthyroidism

COLONEL SIR JOHN LYNN THOMAS K.B.L. (M.G. C.B. F.R.C.S.) Llechryd Wales Motion pictures on orthopedic subjects with introductory remarks

*Commencement Friday October 12—Symphony Hall 8 15 P M*

Conferring of Honorary Fellowships

Presentation of Candidates for Fellowship

Presidential Address The American College of Surgeons—the Past the Present and the Future FRANKLIN H. MARTIN M.D. Chicago

Fellowship Address The Education of the Surgeon WILLIAM J. MAYO M.D. Rochester Minnesota



## PRELIMINARY CLINICAL PROGRAM

## GENERAL SURGERY GYNECOLOGY OBSTETRICS UROLOGY ORTHOPEDICS

## BOSTON CITY HOSPITAL

M d y

WELK MAS N ROBERT M C EN J L T  
 W L G L RICK L GOOD J P I C I  
 HARLD V HYDE FREDERCK J L R KEGIN W D  
 T MARG ON PIERCE J DUN ABR HAM S  
 T UPL d CARM R AL — C ol l  
 doh t tr i al pe to and dem t t i a e

Z d y

D TD D S VELL SOMFR F A R d J M L S J H  
 B N—9 G l g l op at  
 HOR CL BIN E W L L M R M RRI d GEORGE W  
 FA —9 G al u g l p r i n  
 WIL S R M B N A d AR R I K I — Dry  
 l P f ted l f the t m b d duo  
 d um

IR A A W WHITE A d W LUAM R M RI ON— 5  
 I t c p t f th t l r g w th i th  
 t m h f l l g g t i t m y

HORA BEN Y— 5 Th p l ty f b n h t  
 f i t u

G O R L C S I T CK—3 S g l p e t f om  
 t p l m l d e s

J A E S J H BURN—3 4 P t p t e h e m  
 W L L R O H EN—3 5 C e f th g l d b e t c

C S F W I EN—4 5 M ung a r i h m r l g  
 i t b d m l g t t l u b p o l g

i f th u b w t p e r v a t f b th p i p h  
 a d c m p l t f u t f l d k e

W d d

H A L B L E D V H R D I a d THOMAS W  
 WICKIAS—9 C l p t

I V I N J W L A E R R C C C I R r A G T U  
 R L V TH M K P I C I A R D S d C H R E C L N D

—9 G l g al p to  
 C A R L E S C L U N D— D y l n The fluc f  
 h g th b l m t b o l m the c t f

m r p h e  
 R O L E T C C H R A N E— 5 D e m n s t t f th y r d  
 a t B t C t v H p t a l d n g p t a

H A L S E B L D — 5 D e m t t o f of s  
 i d e n d t t l

I R I N J W A L K E R—3 15 E n d e u l t g a l l b l d d  
 u g r y

A L G U S R I L F Y—3 45 N p h o p y f l k e d u t s  
 w i t h l a t r l d o f p e a d p o t p e r a t i d

T I O M S W W I C H M—4 5 R v i w o f e s o f i t e u a l  
 b t r u t i m p l t c l e s n e f t

p i c d i t u

77 d y

F R E D I C J C O T T O N O T T J H E R M A N N J O S E P H  
 S i R E L L A d J O S P H H B U R N T T—9 G e l

S g l p u  
 A R T H U R P K I M P T O N H E R E R T H H O W R D D O N A L D  
 M U N R O D T R A C Y P U T N A M—9 G n l g a l

o p e r a t  
 M A R J E N G I S I d O T T J H E R M A N N— D y  
 c l u r A p p e d e t i n c h i l d r

F R E D R C J C O T T O — 25 D y l n i c H p f a c t u  
 f d r f c t f k t h p l s t y f k n e l b w

d l c t n w i t h l a r n r v l f o u t h l a o f  
 k l f a c t r

J F R I H S H O T E L L— 5 D y c l u s i c D e o  
 e p t c j n t s l a t g l d a r t h o d e s f f t r e d

a l e s l a t e t u o f e e d u l a r n r v e  
 O T T J H F R I A N V a l W I L L A S R M R R I S N—3 1

D y c l u s i S e l a e f p n r e d u t i n d  
 f t s s f f t u r d t b u n d p u n a l a r e t h a

t h P t k i o l t o n l e n g c s f t o m y l  
 t o f l u m t h h a m l y t e s t p t c c u s e p t i c a m i a

D O A L D M N R — 3 5 l a c t u o f e r v i c l s p  
 f a t o l e t o f t h e o t o f f i f t h e v f m a y r

a l g n  
 M A U R I C E I R E M T S I T H — 3 45 M h a n m o f h y d o  
 c p l l

H E R B E R T H H A R D — 4 D e t c l u m o f t h e b l d  
 d t h e e o f o m a f t h e b l d r

F d y

S g i c a l s t f l — 9 C o n f e c e s n d p r t a t i o n o f p a l  
 s u b j t

I R D E I C J C O T T O N H p f r a t s  
 R W A R R E W S (I' g h k e p e N Y ) I m p a t i o i n h u p

f a t u s  
 F A N A R M I L L O R Y P a t h l o g y o f b l e

O T T J H E R M A N N C t u e o f l  
 P A U I B L E R L s o o f t h e l a g b o l

J O I N I H S I R T E L L C r p l j e  
 J O S I I H B U R T T S p h d f r a t

M B R I N V (b y i n v i t a t i o ) I o i t n n t e a t m t f  
 p h d f r a t u e

## LONG ISLAND HOSPITAL

M day

J H C U N N I N G H A M d C S S A N — ( t n a r y  
 l n p r a t o a d d m n t a t i o n o f e s

C H R L S L U N D— T h o f r g i c l d t h m y e  
 e r f t h e t g u e a d m t h

E R L E C C L A R K— S g a l p t h o l g y  
 H R V i s— N u g a l f t u s p t a m g t o

g  
 V B M C M I L L A N— S g i c a l r a y d m o t r t o

H d s d y

R O B R T S O U T T E R— O r t h o p e d c l o p t i o s a d  
 d e m s t r a t f a t r a t i o n i t h t r t m e t o f

f r a t t a t m t o f n g t l h i p  
 E A R L E C C L A R K— S g a l p t h o l g y

H R V i s— 2 N e u s g l f t u p t a t  
 g r y

V B M C M I L L A N— S l r a y d m o t a t  
 C H R L S L U N D— I j c t t e a t m t f s e

p e a t i o n s d d m t a t n f c

F d y

J H C U N N I N G H A M a d C S S A N— G t u  
 p e t

R O B E R T S O U T T E R— O t h p e d t r a t i  
 C H A R L E S L U N D— G e a l g l p e t

E A R L E C C L A R K— S g a l p t h o l g y  
 H R V I E T S— N e r g l f t u p e r t a m i g t o r

g r y  
 V B M C M I L L A — 2 S g i c a l r a y d m t t

## MASSACHUSETTS GENERAL HOSPITAL

## Monday

- Orthopedic Staff—Dry clinics  
 NATHANIEL ALLISON—Tuberculo 1 of the knee  
 P D WILSON—Tuberculo 15 of the spine  
 N M SMITH LECTURE—Tuberculo 1 of the 11th  
 K K GHORMLEY—Internal derangement of the knee  
 NATHANIEL ALLISON and ARMIN KLEIN—Congenital dislocation of the hip  
 J H MANSFIELD and RICHARDSON and CLARK—Hernia—Thyroid clinic  
 MONROE McIVER—3 Obstruction of the biliary tract  
 D WHITE and HOWARD SARGENT—3 Hernia of the inguinal region  
 G A LELAND—4 Fascial repair of the hernia  
 Surgical laboratories open from 2 to 4

## Tuesday

- J D BARRETT and R G O'NEILL (C) SMITH and H CLARK—Tuberculo 1 of the 11th  
 TREL and I H COLBY—9 Genito-urinary internal operation and demonstration of cases  
 Surgical Staff—11 General surgical operation and demonstration of cases  
 W J MIXTER, J B WILSON and J S HODGSON—Surgery of the nervous system, operations and demonstration  
 D F JONES—2 Cancer of the colon and rectum  
 I B McKITTRICK—3 Spinal anesthesia  
 C A PORTER—3 30 X-ray burns  
 J V MEIGS—4 Uterine bleeding  
 A W ALLAN and P SMITHWICK—4 30 Cultures of the diseases of the extremities  
 Staff—2 Demonstrations in surgical research laboratory  
 DRS. YOUNG MALLORY and HARTWILL—3 Cytology Clinic (pathology)

## Wednesday

- Surgical Staff—9 General surgical operation on  
 DR KAZANJIAN—12 Plastic surgery  
 WILMAN WHITTEMORE and DR LORD—Thoracic surgery, operations and demonstration of cases  
 R C CABOT and MISS CANNON—2 Social service  
 H D LLOYD and associates—3 Syphilis in surgery  
 T W HARMER—3 30 Tendon and nerve suture  
 WILLIAM HERMAN—4 15 Psychiatry and surgery  
 Surgical laboratories open for inspection from 2 to 4

## Thursday

- Orthopedic Service—9 Operations and demonstrations  
 P D WILSON and M DANTORTH—Arthritis of the spine  
 NATHANIEL ALLISON and KENNETH COONSE—Arthritis of the knee  
 W ROGERS and W A STRANMER—Arthritis of the hip  
 R K GHORMLEY and HARRY LOW—Tuberculosis of the spine  
 WILLIAM A ROGEE—End results of studies  
 Fracture Service—2 Demonstration of cases  
 B VINCENT—2 Surgery of the spleen  
 J P RICHARDSON—2 30 Hernia through the diaphragm  
 Staff—2 Demonstrations in surgical research laboratory  
 L DAVIS—3 Cancer of the cervix, the duodenum and common bile duct  
 J M HANFORD (Presbyterian Hospital New York)—1 H  
 MILLER and W M SHULDRUP—2 30 Surgical tuberculosis, cervical adenitis  
 I M DALAND—4 30 Plastic surgery

## Friday

- Ether Day Celebration—11 Presentation of bust of Dr W T G. Motion by the Associated Anesthetists

- of the United States and Canada and the International Research Society  
 ROBERT H GREENOUGH, C C SIMMONS and associates—2  
 Tumor clinic  
 GEORGE HOLMES and associates—3 X-ray and surgery

## MITCHELL BRIGHAM HOSPITAL

## Monday

- HARVEY CUSHING—2 30 Neuro-vascular clinic  
 FRANCIS NEWTON—3 30 Diverticulitis  
 CHANNING L ROTHINGHAM—4 Passing of the chronic appendicitis  
 I S LEMERY JR—4 30 Study of the results of medical and surgical treatment of peptic ulcer

## Tuesday

- Staff—9 30 Surgical operations  
 H A CHRISTIAN—2 30 Medical diagnostic and therapeutic clinic  
 (C) BIRT HORRAN—3 30 Cordotomy for the relief of pain  
 J P O'HARE—4 Hypertension and nephritis in relation to surgery  
 DAVID CHUTE—4 30 Surgical laboratory clinic

## Wednesday

- Staff—9 30 Surgical operation  
 M C SOMMER—2 30 X-ray study of myeloid atelectasis of the lung  
 (C) P GRABHILL—3 Effect of drug on the nitrogen metabolism  
 J H HARRIS—3 30 Treatment of varicose ulcer  
 A L FINE—4 Hypertension in surgery  
 S B WOLFE—4 30 Demonstration in surgical pathology

## Thursday

- Staff—9 30 Surgical operations  
 W C QUINBY—2 30 Surgical clinic  
 R H ITZ—3 Insulin in surgical conditions  
 WILLIAM MURPHY and JOHN POWERS—3 30 Treatment of secondary anemia by liver diet  
 HARVEY CUSHING and TRACY PUTNAM—4 Pituitary gland and its influence on growth

## BOSTON DISPENSARY

## Tuesday

- H J INGLIS—Lipiodol injections in the diagnosis of bronchiectasis and lung abscess  
 ARTHUR H CROSSIE and HAROLD CHAMBERLAIN—Cvs to copy and demonstration of cases  
 JOSEPH H IRATT—2 Dry clinic importance of the physician to the surgeon illustrated by cases

## Wednesday

- JOHN D ADAMS—11 Orthopedic operations  
 HILBERT F DAY—11 Injection treatment of varicose veins, demonstration of technique, cases and pathological specimen  
 HARRY FRIEDMAN—11 Demonstration of malignancies treated by radium and X-ray therapy

## Thursday

- A K PAINE—2 Treatment of gonorrhea in women  
 WILLIAM A HINTON—2 Hinton cholesterol reaction, demonstration of technique and relative sensibility  
 MAYNARD LADD—2 Surgical aspects of pyloric stenosis in infants

## HARVARD MEDICAL SCHOOL

T s i v d H d d s

D S WOLB CHAND BLAC FA — Hemat lo c l tud s  
th p alref e et ple t my: hld nBRONSON CROHERS— St d of j i to th spnal  
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W B CANNON— C mpl ted r t of heart ff t  
f t t l ympath et mJ W SCHLRESC v y— C n th ue f h h  
f q n y tLEC L K DRI KER and S I PHEN W v— N oll d  
lut n f t a u j t n ub titute foS v Y Co — M op dem t tio f capill ry  
inj t on f the brH S I RBES — D mo t to of th er br l cu  
l to l t tTh n w l t phy olg c t will be p n f  
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the n y tem

D K M M A — V C I Y I O S P I A L

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PHILIP DRING R N m thods f art fic al p rat n

UR ICAL LAB v — I S S CHU ETTS GE ERAL

I P AL

T d y d T l d j

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t

M S C I S T T GE ER L HOSP AL

H d d a y g

A V B A St d e th phy ology f mu la wrk  
h lth d d eJ C A I t g t n al um m tabel m b r n g  
b gr th a d pW O F r s p s St d thy o d d s e od ne  
d g lth l m got thyr n m y o d m aC M J v s A d a d b e t r by th tomach  
f f p f m the g r nte t l tract

R N U M

Op d l v f z t q p m

D m tr t by DR M CANAVAN Cu t  
Dw ht l l t n f p ltu t at d fo m utomal d a  
Bone t m r s w h y hst n nd m p cs lde and m r p y ble f r m at S me  
f the e p me s w e d in th l t ti them o raph B S r m u d ty the Am ic n  
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ope tonThe p c t u n D N h l olle tion all tratin p h  
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nd u tial pl nt p dd som n y s feo r dTuler l f bone and joints  
Syph l f b o eD l c tion f ends of b es  
Collect on f l d s g cal i strum nts b tet calf ceptu key s f r tract teeth urol gical to l cupp d  
lee h i nstrume ts

## HUNTINGTON MEMORIAL HOSPITAL

H d d y — Dyclin s

F M DALA D d G W TAYLOR C r i oma f th skn  
C C S m tions nd C C LUND Ca c of the t ngd b c al m cos  
C A LELAND nd J V M f i s C r i noma f the ceR B GR enough a d C C SIMMO S v y i d of  
m l g a n y n c aW L I A M M S I D D O V a d L I I H A Y D C a n c of th  
ctumE M H L R M A N nd H V K A Z A N J I A N C cer of th  
antrum nd c es r y s i u s

T l d a y — Dry cl

W D A E d J C H Y P O N The mod n v ray l  
I M D L A N D d W M S H E E D O N C a n e r f th l pG G S M I T H C a m f th g e to u n r y t a c t  
R B G R E O U G H d C C S I M O N C a c o m a f thb e t  
C C S I M O N M l a t b tum rE M D L A N D nd C C L U N L l t o a g u l t o n i s t e  
t e a t m n t f m a l g a n t d e

## NEW ENGLAND BLAONESS HOSPITAL

D I J O N E S and L E L A N D M C K I T T R I C K — o d d l y C n l  
g l c l c e o p a t o n d d m o t t o f aI H I A E Y H M C L U E I L M A S O N d L I S S i s  
— o d l y G e r a l s g c l e m i c p l a x t h ethyro d c e o p t i o d d e m o n t r t i o f  
D I J O N E S d L E L A N D M C K I T T R I C K — d d l y D yl i c C a e r of th l g e i t e s t s g y f  
diabet esE P J O S L E N F G B R I C H M H F F O O T P R I C I L L A  
W R I T E a d W S A N E Y C U R T I S — 3 d d y T r a tm n t f m t h s u g a l d a b e t i d b e t e a d h y p e r  
thyro d mF H L A H E Y H M C L U E a d R L M S O N — 3 d d y  
D r y l n i c G E p l a g l d t i l u m h t f i d ia d h y p e r t h y r d m a r f t h t h y d f i l  
u t r h n r e p t h y o d cS A R A M J O R D A N — 3 d d y I n d c a t f o s g r y  
p p t l e rL M H U R T H A L — 3 5 d l y C a d i n d t i o n s c o m  
p l a t g u r g yL B M O R R S O N — 4 d l y v y d e m o t r t i o d s  
o n d t h p

## FORSYTH DENTAL INFIRMARY

St ff — d d l y S u g l l n c c l e f t p l t e p e t u  
o t r e t D e m t r t o i n r h l b at r e s e f f e c t f v a u s d i e t n b o n d l o p m t d  
p r r

# FREE HOSPITAL FOR WOMEN

## Monday

W P GRAVES and DR SMITH— Dry clinic Gynecological pathology demonstration of specimens and slides

## Tuesday

W I GRAVES FRANK A PEMBERTON and R C WADSWORTH— Gynecological operations Amputation of cervix and caeliotomy (first stage procedure) perineorrhaphy (second stage procedure) hysterectomy for fibroid dilatation and curettage caeliotomy for retroversion

## Wednesday

W P GRAVES FRANK A PEMBERTON and E B SHELLMAN— Gynecological operations Plastic and caeliotomy (reconstruction operation) hysterectomy for fibroid dilatation and curettage caeliotomy for retroversion perineorrhaphy for complete laceration of perineum

## Thursday

W P GRAVES FRANK A PEMBERTON and DR SMITH— Gynecological operations Amputation of cervix and caeliotomy for procidentia plastic and caeliotomy for prolapse (reconstruction operation) hysterectomy for fibroid closure of vesicovaginal fistula

## Friday

W P GRAVES FRANK A PEMBERTON and DR SMITH— Gynecological operations Hysterectomy for aneurysm dilatation and curettage and application of radium for cancer Dry clinic Demonstration of cancer cases treated

# CARNEY HOSPITAL

## Monday

A R MACAUSLAND—2 Dry clinic Traumatic injuries of the hip joint illustrated  
H G LEE— Dry clinic Fractures of the femoral shaft and of the table of tibia wrist joint arthroplasties  
D F MAHONEY—2 Dry clinic Radical operations for carcinoma of the breast and perforating duodenal ulcer with presentation of cases

## Tuesday

F B LUND A MCK FRASER and associates—9 Surgical operations  
F W JOHNSON L E PHANEUF and associates—9 Gynecological and obstetrical operations  
A I BRETT— Dry clinic Ununited fracture of neck of femur bone screws in fractures fusion of spine  
F B LUND E J DENNING and W J BROWNE—2 Dry clinic chronic duodenal ulcer  
F W JOHNSON—2 Dry clinic End results following in terposition operation for uterine prolapse (lantern slides)

## Wednesday

D F MAHONEY W J BROWNE and associates—9 General surgical operations  
F W JOHNSON L W PHANEUF and associate—9 Gynecological and obstetrical operations  
P N JEFFERY—2 Dry clinic Relative value of various types of operative bone splinting including the massive bone graft treatment of chronic arthritis of the spine operative and non operative incidence recognition and treatment of spondylolisthesis over correction of deformities in fractures

A MCK FRASER—2 Dry clinic Caecostomy in acute appendicitis with peritonitis pre-entation of case  
I F PHANEUF— Dry clinic The low or cervical caesarean section (lantern slides)

## Thursday

F B LUND A MCK FRASER and associates—9 General surgical operation  
F W JOHNSON I F PHANEUF and associates—9 Gynecological and obstetrical operations  
W R MACAUSLAND— Dry clinic Mobilization of the knee and elbow  
M H BLOOMBERG—2 Dry clinic Scoliosis and club foot  
F J DENNING—2 Dry clinic Postoperative medical problems pre-operative treatment in cardiac cases  
L E PHANEUF—2 Dry clinic Uterine bleeding (lantern slides)

## Friday

D F MAHONEY W J BROWNE and associates—9 General surgical operations  
I W JOHNSON L E PHANEUF and associates—9 Gynecological and obstetrical operations  
A SARGENT and B A COVY—2 Orthopedic clinic  
L J DENNING—2 Dry clinic Intestinal parasites in immigrants  
W J BROWNE—2 Dry clinic Fractures and injuries of the hand and forearm pre-entation of special splints  
L E PHANEUF—2 Dry clinic Appendicitis and pregnancy

# ROBERT BRIGHAM HOSPITAL

## Tuesday

H A WILSON—2 Focal infection in chronic arthritis gastro-intestinal studies  
H T SWANN—3 Types of arthritis with X-ray studies and orthopedic principles in the treatment

## Wednesday

P D WILSON—2 Operation for knee deformities  
L T SWANN—3 Demonstration of orthopedic apparatus

## Thursday

L M SPEAR— Circulatory conditions in arthritis  
L T BROWN—3 Mechanical conditions of the low back

## Friday

P D WILSON—2 Orthopedic operations and demonstration of cases orthopedic principles in the treatment of chronic arthritis

# CAMBRIDGE HOSPITAL

## Tuesday

Staff—9 General surgical clinics operations and demonstration of cases

## Wednesday

J W SEVER and F A FINDLAY—9 Orthopedic clinics operations and demonstration of cases

## Friday

Staff—9 General surgical clinics operations and demonstration of cases

## MASSACHUSETTS HOMEOPATHIC HOSPITAL

*M d y*  
 T E CHAND R nd H J LE — (e l g l  
 l Ope t d d m t t f  
*T d*  
 C T HOWARD d C CRA F — S g l o p t  
 R C WIGG — d S V — U l g al p t  
 S W E — H — V d m t t n  
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*W d d y*  
 T F C — d C D H — S g l l  
 t  
 A G H — R S L MAR — d l ( H R — )  
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*Tl d y*  
 J E B — d C C — S h l i r t  
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*F d y*  
 F F C — d C C R V — S h l p t  
 J I BRI — d H J LE — S g al o p t

## ST ELIZABETH'S HOSPITAL

*T d y*  
 C F KENN — S g l l m Ap p dect m l  
 t t m  
 J S H S R — S g l l Thy d  
 f tr t t m  
 W F D — S g l l I gu l h  
 C J K — I l p f t r u  
 I T JAN — I gu l h d l l æ t l  
 H S R — App d t my  
 A L C — I B D W ICE — Dry l  
 G t y e d l t d l t  
 T J S — G l g l m t  
 f c D — C f f p t  
 d v th p v e t f fte p t  
 I McC — P t p t h y l p d

*W d d y*  
 I T JA — S g al l m App e d t my h  
 l v t t m  
 C F K E N — S u g l l Ch l v t t my  
 I R D L V — S p l p l t a e t  
 J S ANTON — Thy d  
 R S H A — K t l g  
 T I B RIC — R t r u t f h u p l t c o  
 k n j t  
 T F BROD ck d R F S LLIVAN — Dry l c  
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 F T JA T E — E d l t m f t p e r a t a d  
 p r a t l l d l e a d t m e t f m l g t  
 d

DR H ALEV — I t e t g t g e g m  
 Jo N D L V — S u g l p t o f p d t

*Tl d y*  
 T I BRO ERICK — S g l l Sp H o  
 A L C HUTE — P t a t c t my t m r f b l d d r  
 n p h t my  
 J S E L H STANT — C t e t o t my chole y t c  
 t m v p p e d c t my  
 H S R V — Hy t e c t o m y  
 C F K E AN — O c y t  
 A H CRO — S n p h t o m y  
 J E P H STANT — Dry l n c Ho gla stom a h  
 f l r o m f l o t h t m t t t i t s c p t o  
 e r c m f l p d  
 J J SULLI — f e m f l l w g d m n t t i n o f  
 l k a l e f t a t m t f d o d e l l e  
 L J L O L I — P t p t p t c y s t  
 H S R V — S g al

*F d y*  
 I J I U I — S u g l c l c A l l d c t my chle  
 y t e t o m y  
 H S R F N — Chol c y t o m y  
 J S T A N T O — App d c t o m y h y s t e c t o m y  
 C I K L A — V t l h n p p e d e c t o m y  
 C F K I C — C a a e t i n  
 I F J Z E N — I f u l h n a u n d e r l o c l æ s t h  
 G I K E F N A — D y l n c P o t o p t f t u e f  
 k l l p t o p t u e t t n f h e t  
 M H S E L L M A — L d l t i n f r a t e s o f s k l l

NEW ENGLAND HOSPITAL FOR WOMEN  
AND CHILDREN

*T d y*  
 L D ADA IS B L ATWOOD and GRACE ROCHFORD —  
 G y n l g l o p t  
 B I A T R O O D E M C A L G I T O M A R I O V N O T E —  
 C a a t n p t d l i i f d b l e  
*W d d y*  
 M R I N N T — D m t t n o f u l b t t n l  
 e r y d w d w l k p a t a l l  
 L D A M B L A T R O O D and GRACE ROCHFORD —  
 G y n c o l o g l p e r t

*Tl d y*  
 C ACE ROCHFORD and OLGA LARA — D m t r a t f  
 p t p t c p h l g i c a l s p i m  
 I L E B L E and I W R I T — D e m t a t f  
 b d e l n s

## CLINICS ON INDUSTRIAL SURGERY

At t l e e l t o b h e l d t l e o f f t h e M d l  
 D t f f t h A m M t a l L a b u r y I n s t  
 C m p y l l b h w n t o i l l t r a t d g  
 t t m e n t a d d e u l t

*T d y*  
 F R N E S A C D M A N — S h l d e r j  
 E A R L Y O U N G — I n g u a l p n w t h u t h

*W d d y*  
 F O D J C O T T O N — R t r u c t n u g r y d t r y  
 J A D A D A M S — I J t t h e b k

*Th d y*  
 P D W I L S O N — I a c t u f t h e o c a l c s n j u t  
 t h e k e  
 R L S J A C O B Y — I d u t i a l d m t l g y

*F d y*  
 J H N D H G S O N — F t o f t h e k u l l  
 H A R R Y C S O M O N — I d t a l n e l g y  
 H E N R Y C M A R L E — H e

## PALMER MEMORIAL HOSPITAL

## Tuesday

Staff—2 Deep X ray therapy clinic demonstration of prevention of peritoneal adhesions pathological demonstration

SHIELD WARREN—Prevention of peritoneal adhesion by amniotic fluid experimental and clinical results

## Wednesday

Staff—9 Operations illustrating treatment of various types of malignancy

## Thursday

L S McCLITRICK, DR McCLEURE and DR BENNETT—Follow up and radium clinics general surgery

SHIELDS WARREN—2 Prevention of peritoneal adhesion by amniotic fluid experimental and clinical results

## Friday

GEORGE A LELAND JR and J V MEIGS—Follow up and radium clinics gynecology

## CHILDREN'S HOSPITAL

## Monday

R B OGDON, W F LADD and associates—Fracture conference combined surgical and orthopedic clinic

## Tuesday

Surgical staff—9 General surgical operation followed by dry clinic

WILLIAM E LADD Hare lip and cleft palate

C G MIXTER Contracture and plastic

H W HUDSON Anomalous

G D CUTLER and KENNETH BLACKFAN Medical aspects of empyema and lung abscess

Orthopedic staff—2 Dry clinic infantile paralysis

W L ASCOCK and E H LUTHER Epidemiology of urticaria

S M FITCHET Demonstration of apparatus for reduction of deformity in early cases

MISS MERRILL Muscle training

FRANK OBER Tendon transplantation

J W RYERSON (Chicago) and A T IFEGG Stabilizing operations

A T LEGER Operations

FRANK OBER Moving pictures

## Wednesday

W F LADD, R B OGDON and associates—Combined clinic of surgical and orthopedic services present policies in the treatment of glandular intra abdominal bone and joint tuberculosis

I B OGDON, W F LADD and associates—2 Combined clinic of surgical and orthopedic services osteomyelitis acute chronic circumscribed Brodie's abscess septic joints types of infection and treatment

## Thursday

Orthopedic staff—9 Dry clinic

ALFRED TAYLOR (New York) and J W SEVER Conference on obstetrical paralysis with lantern slides and moving pictures

GREGMAN ALLEN F SMITH (New York) W B CANNON and A H BREWSTER Conference on syphilitic paralysis

BROOKS CROTHERS and Miss TRAINOR Muscle training A H BREWSTER Stoeffel operation

Surgical staff—2 General surgical operations followed by dry clinic

C G MIXTER Urinary obstruction and infection

W F LADD Kidney stone

THOMAS LAMMAN Hernia and undescended testicle

C G MIXTER and S B WOLBACH Kidney tumors pathological aspects

## Friday

Surgical staff—9 General surgical clinic

WILLIAM E LADD Pyloric stenosis

C D CUTLER Idiopathic peritonitis

ALGISTUS THORNDIAKE Appendicitis

C G MIXTER Intussusception

WILLIAM E LADD Obliteration of bile ducts

Orthopedic staff—2 Dry clinic

ELLIOTT G BRACKETT (Cincinnati) and H J FITZSIMMONS

Conference on torticollis followed by operation

I D DICKSON (Kansas City) and R SOUTTER Conference on congenital dislocation of hip followed by closed reduction and half operation

## NEW ENGLAND BAPTIST HOSPITAL

## Tuesday

I L YOUNG JR, D L JACKSON, H B LONER and D J BRISTOL JR—9 General surgical clinic operation and demonstration of cases

## Wednesday

F H LAHR and H M CLUTH—9 Surgical operations

SARA M JORDAN and E KEEFER—Gastroenterological clinic

## Thursday

E I YOUNG JR, D L JACKSON, H B LONER and D J BRISTOL JR—9 General surgical clinic operations and demonstration of cases

## BOSTON Lying-IN HOSPITAL

## Tuesday

Staff—9 Dry clinics

B E HAMILTON Heart disease in pregnancy

F S NEWELL Treatment of pregnancy complicated by heart disease

S BERNAN End results in pre-eclamptic toxæmia

F C IRVING Treatment of pre-eclamptic toxæmia by removal of blood plasma and reinfusion of corpuscles

I C CRABTREE Clinical aspects of preeclampsia in pregnancy

C C PRATHER The postpartum bladder

## Wednesday

Staff—9 Obstetrical operations

## BETH ISRAEL HOSPITAL

WYMAN WHITEMORE and associates—9 daily General surgical clinic

F C CRABTREE—9 daily Urological clinic

MARK ROGERS—9 daily Orthopedic clinic

HERMAN BLUMBERG Demonstration in medical research department

## BOSTON UNIVERSITY SCHOOL OF MEDICINE

(Evans Memorial Building)

S R MEAKER and A W ROWE—Wednesday and Friday Studies in sterility

A W KOWF and C H LAWRENCE—2 Wednesday and Friday Endocrinology

## TUFTS COLLEGE MEDICAL SCHOOL

TIMOTHY LEARY—2 daily Demonstration of specimens illustrating results of traumatism especially cranial and cerebral

## SURGERY OF THE EYE EAR NOSE AND THROAT

## CLINICAL DEMONSTRATIONS

*Tuesday P M—Gorgian Room Statler Hotel*

- C B FAUNCE M D Boston Brain Abscess Cases Lipiodol Injections in Brain Abscess  
H I CAHILL M D Boston Report of a Case of Cerebellar Abscess  
D C SMYTH M D Boston Lipiodol Injections in Lung Abscess  
LOUIS M FREEDMAN M D Boston Lipiodol Injections in Lung Abscess and Maxillary Antrum  
E W HERMAN M D Boston Two Cases of Foreign Body in the Tracheo Esophageal Wall  
H G TOFFY M D Boston The Results of the Examination and Treatment of 1000 Cases of Asthma  
J M WHEELER M D New York E A I BROWN M D Chicago and GEORGE S DERBY M D Boston Our Mistakes in Ophthalmology

*Wednesday P M—Gorgian Room Statler Hotel*

- Instruction of manual dexterity with minimum requirements for general hospital caring for ophthalmological, otological and otolaryngological patients. See detailed program under Hospital Conference

*Thursday P M—Gorgian Room Statler Hotel*

- D H WALKER M D Boston Lipiodol and the Deaf Child Aid to Hearing  
C D KNOWLTON M D Boston Animal Studies in the Regeneration of the Antral Mucous Membrane  
L A SCHALL M D Boston Microscopic slides illustrating pathological conditions of the antrum  
D W DREARY M D Boston The Results of Tympanometric Tests in Cases of Chronic Deafness  
F B HOLLOWAY M D Philadelphia Vascular Relations at the Base of the Brain  
F H VERHOEFF M D Boston Ophthalmic Pathology

*Friday P M—Gorgian Room Statler Hotel*

- J H WAITE M D Boston Diagnosis in Glaucoma  
W B LANCASTER M D Boston Operation vs Miotics  
A GREENWOOD M D Boston Handling of Secondary Glaucoma  
H P CAHILL M D Boston Lantern slide demonstration of serial sections of the ear  
F E GARLAND M D Boston Infection of the Submaxillary Gland Cussion of Treatment  
A H KAZANJIAN M D Boston Plastic Operations on the Tip of the Nose  
H P MOSHER M D Boston Report of a Case of Cavernous Sinus Thrombosis Description of Operation Autopsy Findings (Microscopic slides showing pathological findings in both eyes)

## MASSACHUSETTS EYE AND EAR INFIRMARY

*Tuesday*

Ophthalmology

Staff—Ophthalmologist, resident, fellows

- J M WHEELER Resident  
G S DEBY Lecturer  
H B CRIEMER Teacher  
J H WATSON Student  
L B DUNPHY Resident  
B S CHES Perimeter  
H K MESSENER Physiologist  
JAC CHANDLER Light  
F L TERRY Pathology  
IDA E RIDGEWAY Sighting glass

Otolaryngology

- H A BARNES—Otolaryngologist, Malgaigne's case  
H G TOBY—Otolaryngologist, Simple mastoidectomy  
PHILIP HAMMOND—Otolaryngologist, Radical mastoidectomy  
H I CAHILL—Otolaryngologist, Wigglesworth's anastomosis  
Skin graft of the eyelid  
Lidectomy of the eyelid

- DR WRIGHT—Ophthalmologist, Dystrophia myotonia  
G L POSEY—Laryngologist, Laryngeal stenosis  
I M RUCKENSTEIN—Dentist, Treatment of method for  
Merkley's method

*Wednesday*

Otolaryngology

- C H POIRIER—Otolaryngologist, Mohr's trachymalacia  
C T POTTER—Otolaryngologist, Laryngeal stenosis  
G H POIRIER—Otolaryngologist, Tonsillectomy, Stenosis  
H I CAHILL—Otolaryngologist, Tonsillectomy, Stenosis  
P I MELTZER—Otolaryngologist, Tonsillectomy, Stenosis  
A S MACMILLAN—Dentist, Treatment of cleft palate

Ophthalmology

- Staff—Ophthalmologist, resident, fellows  
W B LANCASTER Eye physician  
J B AYER and G S DERBY Eye physician  
MAUD CARVILL Ocular therapist  
J H WAITE Ophthalmologist  
P A CHANDLER Perimetry

B SACHS External diseases  
H K MESSENGER Physiological optics  
PAUL CHANDLER Light sense  
T L TERRY Pathology  
IDA F RIDGEWAY Signifying class

*Thursday*  
Otolaryngology

V H KAZANJIAN—9 Plastic operation  
D C SMYTH—9 Dry clinic The fluorocope and the removal of metallic foreign bodies safety pin  
DR KIRBY—9 Barán's fallacie  
H P MOSHER—10 Exhibition of oesophageal instruments demonstration of the fluoroscopic examination of the oesophagus  
A S MACMILLAN—11 Lantern slide demonstration of oesophageal cancer

Ophthalmology

Staff—9 Operation and demonstrations of cases  
T B HOLLOWAY Thyroid eye cancer  
A GREENWOOD Eye operations  
S J BEACH Refraction with angular type  
W B LANCASTER Muscle  
H B C RIEMER External diseases  
E B DUNPHY Perimetry  
H K MESSENGER Physiological optics  
PAUL CHANDLER Light sense  
T L TERRY Pathology  
IDA F RIDGEWAY Signifying class

*Friday*  
Ophthalmology

Staff—9 Operations and demonstrations of cases  
F H VERHOEFF Eye operations  
W H LOWELL Muscles  
AMY SMITH Social work  
H K MESSENGER Physiological optics  
PAUL CHANDLER Light sense  
T L TERRY Pathology  
IDA F RIDGEWAY Signifying class

Otolaryngology

V H KAZANJIAN—9 Dry clinic Correction of deformities of the face and nose lantern slide demonstration  
H P MOSHER—10 Dry clinic Punch tracheotomy  
A S MACMILLAN X-ray of thymus (lantern slides)  
F J GARLAND—11 Histological exhibition of laryngeal tumors

## HARVARD MEDICAL SCHOOL

*Tuesday*

LUCIEN HOWE—2 Ophthalmic ergograph writes automatically the story of ocular fatigue and relation of this fatigue to eye strain  
H P MOSHER—2 Mohr's Toti lachrymal sac operation demonstration on cadaver  
C B FAUNCE and P E MELTZER Anatomical exhibition of temporal bone specimens

*Thursday*

LUCIEN HOWE—1 Ophthalmic ergograph writes automatically the story of ocular fatigue and relation of this fatigue to eye strain  
H P MOSHER—2 Demonstration of method in postgraduate teaching of laryngology  
M H TURIF—3 Exhibition of temporal bone specimens

## CHILDREN'S HOSPITAL

*Tuesday*

LYMAN G RICHARDS and associates—9 Dry clinic Live dissection of the oesophagus Fulminating infection of the antrum in children Modified radical mastoid operation in children

LYMAN G RICHARDS EDWIN A MESERVE and DR CLINE—10 Nose and throat operations

*Wednesday*

LYMAN G RICHARDS and associates—9 Sinus thrombosis in retro cleft Some thoughts on postoperative healing in acute mastoiditis Typhoid fever and mastoiditis in children

LYMAN G RICHARDS EDWIN A MESERVE and DR CLINE—10 Nose and throat operations

*Thursday*

LYMAN G RICHARDS and associates—9 Dry clinic Some bronchial foreign bodies and experiences attending their removal A group of laryngeal obstructions with tracheotomic complications Bronchiectasis in children

LYMAN G RICHARDS EDWIN A MESERVE and DR CLINE—10 Nose and throat operations

## CARNEY HOSPITAL

*Tuesday*

WILLIAM LIEBMAN—9 Eye operations and demonstration of cases X-ray localization and magnet extraction of foreign bodies

*Wednesday*

I D HURLEY and W S LIEBMAN—9 Eye operation and demonstration of cases

*Thursday*

WILLIAM LIEBMAN and H BORNHOFF—9 Eye operation and demonstration of cases

*Friday*

W J SKEHAN and F G MINSTER—Otolaryngological clinic

## MASSACHUSETTS HOMOEOPATHIC HOSPITAL

*Tuesday*

W D ROWLAND—9 Eye clinic  
F W COLBURN and H L BABCOCK—9 Aural clinic

*Thursday*

W D ROWLAND—9 Eye clinic  
C SMITH C W BUSH L R JOHNSON R O PARRIS and W W WALKER—9 Nose and throat clinic

*Friday*

W D ROWLAND J C STERNBERG H M EMMONS and J J SKIRBALL—9 Eye clinic

## BOSTON DISPENSARY

*Tuesday*

H J INGLIS—2 Beck-Schenk snare method of tonsillectomy

*Wednesday*

JOSEPH G SKIRBALL—10 Eye clinic demonstration of cases external disease—perimetry ophthalmological cooperation with syphilis clinic

*Thursday*

I J SKIRBALL—10 Ocular diseases



## ST ELIZABETH'S HOSPITAL

T e d y

W T H ey—g M t d a d t o l

W d n d

P S M A A —g E l e t o n f l e v

J B e t n s—g F l l t m

I d

W T H L A —g I t l l t

J B R —g M t l p t

W T H A L — I d u l t n d l u o p a t o

## CAMBRIDGE HOSPITAL

N S B d r J B T R—g I h u d y N o a d  
th t lNEW ENGLAND HOSPITAL FOR WOMEN  
AND CHILDRENM N K L I N E R T n d I D K E R R—g T u d a y n d W d n e s  
d y E a r n o e a n d t h t c l n o p a t o n a n d  
d e m o t t o n o f a c

## BETH ISRAEL HOSPITAL

L A F R I E D M A n d L A R K I N—g d i l y N a d t h o u t  
c l n i c

W I L I A M L I E B M A N—g I r d a y J v c l n i c

## BOSTON CITY HOSPITAL

J J C O R E T T—g d i l y E y c l n i c

## CAPMA HOSPITAL

E D H U R L Y—g d i l y F y l n i c

## ANNUAL HOSPITAL STANDARDIZATION CONFERENCE

Monday 10 00—Ballroom Copley Plaza Hotel

GEORGE D STEWART M D New York Preiding  
Address of Welcome FREDERIC A WASHBURN M D  
Boston Director Massachusetts General Hospital  
The Role of the American College of Surgeon in Improving  
Hospital Service GEORGE D STEWART M D New  
York President American College of Surgeon  
Presentation of Annual Report of Hospital Standardization  
and Announcement of Approval Letter to  
M T MACACIER M D Chicago Associate  
Director American College of Surgeon and Director  
of Hospital Activities

Health Inventoriums in Approved Hospital—Further  
Progress of Research FRANKLIN H MARTIN M D  
Chicago Director General American College of Surgeons

The Interest and Influence of the Duke Endowment in  
Hospital Standardization W S RANKIN M D  
Charlotte N C Director The Duke Endowment  
Nurse Patients and Pocketbooks MAY AYER BLUES  
Ph D New York Director Committee on the Teaching  
of Nursing School

General Discussion CHARLES F WILNSKY M D Boston  
Director of Beth Israel Hospital WILLIAM DARRACH  
M D New York Dean College of Physicians and  
Surgeons Columbia University MARY M ROBERT  
RN New York Editor American Journal of Nursing  
and CHARLES H MAYO M D Mayo Clinic

Monday 11 00—Ballroom Copley Plaza Hotel

GEORGE D STEWART M D New York Preiding  
Medical Pedagogic Opportunity Incident to the Usual  
Organization of the Resident Medical Staff of the  
Hospital HENRY A CHRISTIAN M D Boston  
Harvey Professor Theory and Practice of Physics  
Harvard University Medical School

Medical Education and Specialization WILLARD C  
RAPPEYE M D New Haven Director of Study  
Commission on Medical Education  
Experimental Science versus Imitation Art in Medicine  
E MURRAY BLAIR M D Vancouver B C

What Is the Role of the Hospital Administrator? F F  
CHAPMAN Cleveland Director Mt Sinai Hospital  
Visual Methods in Conducting the Staff Conference (Illustrated)  
C G PARALL M D Rochester N Y  
Director Rochester General Hospital President-elect  
American Hospital Association and HARRY D  
CLOUGH M D Rochester N Y Assistant Medical  
Director Rochester General Hospital

General Discussion on CHARLES H YOUNG M D Portland  
Maine Director Maine General Hospital and JOHN  
T BURRIS M D High Point N C Surgeon High  
Point Hospital

Tuesday 9 30—Ballroom Copley Plaza Hotel

JOSEPH B HOWLAND M D Boston Superintendent  
Peter Bent Brigham Hospital Preiding  
The Educational and Economic Value of the Outpatient  
Department in a General Hospital JAMES RAGLAN  
MILLER M D Hartford Assistant Gynecologist and  
Obstetrician Hartford Hospital  
Selected Economic Basis for Outpatient Service (Illustrated)  
BEATRICE KAIFFER Detroit Clinic Executive  
Director Hospital

Minimum Standard for the Hospital Social Service Department  
MARLENE WILSON RN Boston Director  
Social Service Department Children's Hospital  
The Operation of a Physical Therapy Department from the  
Scientific and Economic Standpoints JOHN S  
COLLIER M D Chicago Assistant Professor of  
Physical Therapy Northwestern University Medical  
School  
Discussion MICHAEL M DAVIS Ph D New York Consultant  
Hospital and Community Surveys and IRVING GRANGER M D Boston  
Director of Physical Therapy Department Boston City Hospital

Tuesday 10 00—Ballroom Copley Plaza Hotel

Clinical Case Record in Hospitals Directed by C W  
MUNGER M D Valhalla N Y Director Grasslands  
Hospital

What Constitutes a Good Case Record? ERNEST LEROI  
HUNT M D Worcester Surgeon and Director of  
Physical Services Worcester City Hospital

What Are the Best Methods of Appraising Case Record  
HAROLD W HERSEY M D Bridgeport Superintendent  
Bridgeport Hospital

What Part Should the Record Librarian Play in Promoting  
Efficient Case Record in the Hospital? GRACE W  
MYERS Boston Librarian Emeritus Massachusetts  
General Hospital

How Best Can Good Case Record Be Maintained in the  
Small Hospital Where the Usual Difficulties—Lack  
of Internes Shortage of Funds and No Historian or  
Record Librarian—Are Frequently Found? CLARA  
A DOOLITTLE Derby Conn Historian Griffin  
Hospital and President Connecticut Hospital  
Historians Association

What Are the Most Effective Ways and Means of Stimulating  
Good Case Records? EYMA C BLACK New Haven  
Record Librarian Grace Hospital

What Should Be the Functions of a Record Committee of  
the Medical Staff? E W WILLIAMSON M D  
Chicago Chief Field Representative American  
College of Surgeons

What Are the Most Effective Means of Keeping Current  
Case Records up to Date? R C BUEKEL M D  
Madison Superintendent Wisconsin General  
Hospital

What Are the Relative Advantages or Disadvantages of the  
Various Filing Systems? EDITH M ROBBINS Boston  
Chief Record Librarian Peter Bent Brigham Hospital  
The Organization and Functioning of a Central Record  
Department GENEVIEVE CHASE Boston Record  
Librarian Massachusetts General Hospital

Wednesday 9 30—Ballroom Copley Plaza Hotel

Open Forum—Problems Involved in the Professional Care  
of the Patient Directed by LEWIS A SEXTON M D  
Hartford Superintendent Hartford Hospital

Measuring the Professional Efficiency of the Hospital  
JOSEPH C DOANE M D Philadelphia Superintendent  
Philadelphia General Hospital

Standard of Surgical Efficiency GEORGE W SWIFT M D  
Seattle Surgeon Children's Orthopedic and King  
County Hospitals

Medical Staff Organization T T MURRAY Albany  
Superintendent Memorial Hospital





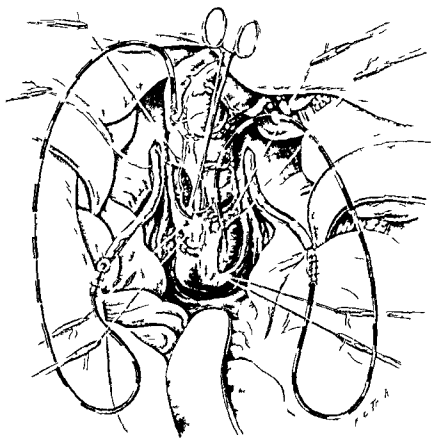


Fig. 4. Attaching end of the tongue with the band.

*Laparotomy of the Ureters at the Large Intestine — Robert C. Fey*

# SURGERY, GYNECOLOGY AND OBSTETRICS

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NOVEMBER 1928

NUMBER 5

## TRANSPLANTATION OF THE URETERS INTO THE LARGE INTESTINE

BY ROBERT C. COLLEY, M.D., F.A.C.S., PORTLAND, OREGON  
CLINICAL INVESTIGATIONS IN UROLOGY

### FUNDAMENTAL PRINCIPLE

It would seem that the valve is the only mechanism by which fluids and gases at a given temperature may be transmitted from a chamber of low pressure to one of higher pressure. Without the controlling influence of the valve the tremendous energy of expanding steam and gasoline would be futile and powerless. Therefore it may be truthfully said that without the valve principle our present civilization could not possibly exist.

A valve is a non motile movable gate or obstruction which is located at the threshold or in the course of a cavity or canal and which automatically closes and prevents reflux during the intervals between intermittent applications of the necessary force used in the transmission of fluid matter from an area of lesser pressure into one of greater pressure. In the higher animal mechanism there are various conditions under which it is necessary to transmit vital fluids forcibly. Under all of these conditions and in all of these locations non motile membranous valves are found. The most important of these valves are those connected with the heart and blood vessels and those at the entrance of the ureters into the bladder and of the bile duct into the duodenum. Without these valves human life and indeed all higher animal life would be impossible. Therefore

it may be said that the valve is the most fundamental principle or mechanism connected with the activities of our world.

### CHRONOLOGICAL STEPS IN THE DEVELOPMENT OF THE OPERATION

Since the dawn of modern medicine doctors realizing the successful arrangement of the cloaca in fowls for the common reception of the urine and feces have hoped that under certain circumstances a similar arrangement might be surgically produced in the human being. A review of approximately 250 articles dealing with experimental attempts to produce this condition has shown that not one author had up to 1909 constructed a true non motile valve such as exists in ordinary mechanics or in the cardiovascular system at the mouth of the ureters or at the mouth of the bile duct. The presence of muscle fibers near the outlet of these channels seems to have misled the investigators. All reports of experimental attempts to transplant the ureters into the large intestine of dogs prior to 1909 failed to reveal a single instance in which a series of live dogs with undamaged kidneys could be exhibited. There were three notable instances however in which a degree of success had been attained by a near approach to the desired solution. Since these three operations have caused a certain amount of confusion I shall therefore in the interest of clarity and

of fairness quote from the reports published by the three authors

*Fowler operation* George R. Fowler in his *Treatise on Surgery* (1906 11, 313) described his operation as follows

Uteral and rectal anastomosis offers an ideal method of dealing with the inconveniences and discomforts of extrusion of the bladder were it not for the large orifice of the kidney.

In the case in which I implanted the ureters into the rectum putting the opening of the former by means of a flap of mucous membrane and further provided against infection by placing the ureters in the grasp of the circular fiber of the bowel wall the patient reported no further urinary symptoms would develop again. This fact. Over 10 years have elapsed since the operation and the patient now grows to be a young man has apparently suffered no inconvenience from the presence of the opening of the ureters into the rectum.

The four steps of the technique are shown in Figure 1.

It will be observed that Fowler attributes the success of his operation to two features: the mucous membrane flap within the bowel and the muscular action of the intestinal wall around the ureter.

It is at once apparent that this little tongue of mucous membrane after the catgut attachment, the ureter to it has absorbed would hang as a loose tag in the intestine and would gradually atrophy. All of the muscular action around the ureter would be no greater than any other direct implantation. And yet Fowler's operation succeeded in this case. Why did it succeed? In Figures 1 A and B showing the outline of the tongue of mucous membrane in the diamond shaped space it will be observed that above the cut flap is a small triangular area of mucous membrane (indicated by an asterisk) which has been loosened from the muscular coat for the short space intervening between the point of entrance of the ureters at the upper angle of the wound and the turning in of the mucous flap. For this distance the ureters actually ran between the mucous coat and the muscle as indicated in F and G (identified by arrows). Figure 1 E shows a sectional view of the mechanics of the operation as described in the text by Fowler. 1 and G show what really happened as a result of the Fowler operation as shown by his pictures. Arrows point to the

submucous space traversed by the ureter. This space corresponds to the space in A and B indicated by the asterisk. G indicates the probable result in Fowler's successful case. The mucous flap hangs as a useless tag. Arrows point to the short submucous space traversed by the ureter which constitutes a short valve. This feature of the result was apparently overlooked by Fowler. Our present day success with implantation of the ureter shows that without doubt this factor accounted for Fowler's success. He had inadvertently applied the principle of submucous implantation and had not recognized it as an essential part of his success.

*Martin operation* As early as 1898 Franklin H. Martin was absorbed in a dream of the radical removal of the uterus and bladder for cancer which involved both of these organs and fully recognized that the chief desideratum in this connection was a practical disposition of the ureters. The following paragraph gives his view on this phase of the question at that time.

*Transplantation of the ureters to the rectum* sigmoid flexure is the method which literature indicates has been accepted as the most reliable one by the majority of experimenters in spite of the objections which may be urged against it. In my experiments in this line I have accepted the large bowel as the best substitute for the bladder first because it possesses reservoir room second because it has emptying power under the control of the individual and finally and principally because it has a perfect sphincter outlet also completely under the control of the individual.

No more earnest industrious and intelligent experimental surgery has ever been done in connection with this subject than that of Martin. For several years he worked on animals attempting to solve the problem of transplantation of the ureters. During this time he had at least one dog that survived the operation for 3 months and at postmortem examination showed a fairly good kidney. Nevertheless Martin gave up in despair as to the value of experimental work and expressed himself in the following words:

I am convinced that work on animals will never solve the problem of ureterorectal anastomosis. The care of an animal cannot be such that one can minimize as in the human several sources of danger of infection. For example Gravity as it is

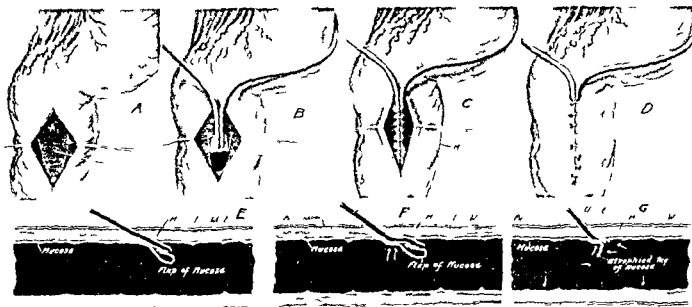


Fig 1 Fowler operation A Incision in the rectal wall including the mucous and muscular coats Mucous membrane exposed in a diamond shaped area and the edges of the incision retracted by thread retractors The dotted line shows the line of section of the mucous membrane to form the tongue shaped flap B Tongue shaped flap cut and turned back The ureters are placed with their obliquely cut end lying on the surface of the flap and secured

in place by chromicized catgut sutures C Flap valve and ends of ureters placed in the rectum and a row of chromicized catgut sutures closing the gap in the mucous membrane D Showing the longitudinal incision in the bowel wall closed by a row of silk sutures The ureters are shown passing into the upper angle of the closed incision E Anterior interrotation of Fowler technique F and G redrawn from Fowler's *Treatise on Surgery*

exerted on the urine of the ureters in the upright human is lacking in the horizontal animal The rectum of the human patient can be rendered and maintained relatively clean The usual location of the implantation in the animal (anterior or lateral wall of the rectum) makes the mouths of the ureters at the most dependent portion of the bowel when the animal is lying standing and walking much more subject to infection The opposite is the case with the human and too the patient can be so controlled that ureteral catheters can drain the ureters for several days after the operation and the mouths of the ureters protected entirely from infected material thus giving a start and an immunity when the resistance of the tissues are at their lowest tide

As far as the printed record shows Martin was never able to realize his dream of transplanting the ureters coupled with removal of the uterus and bladder for carcinoma He reported on one dog which lived 3 months and at the postmortem examination was found to have a fairly good kidney as shown by the following pathological report by Professor Zeit of the Klebs Pathological Laboratory

The absence of pyelitis in this case contrasts markedly with the findings of former postmortems before this Society and speaks in this case against an ascending infection from the rectum up If the

left kidney can be taken as a criterion of what is to be expected after such operations the results might be considered in a more favorable light It is possible that this left kidney shows what would have become of the right kidney if the dog had been allowed to live (The left kidney showed in the middle of the convex border a nodular appearance similar to that of the granular kidney of chronic interstitial nephritis)

This was a better result than had been accomplished by previous attempts at direct transplantation of the ureter into a dog's bowel by other investigators

The following is Martin's description of his operation

1 Place the patient in a Trendelenburg position make the abdominal incision so as to expose the rectum prick back the omentum and intestines make a longitudinal incision of the peritoneum over the ureters down to their insertion into the bladder and dissect them out with the finger to a height of about 3 inches 2 In each ureter near the bladder with strong silk and sever it above that point

Bring both ureters forward and approximate them in front of the rectum by including the wall of each in one fine silk suture tied in a hard knot and armed at each end with long cambric needles Approximate the ureters further by fine catgut sutures passed through the outer walls of the ureters only securing the 2 tubes parallel for a distance of 2 to 3 centimeters Place the severed ends



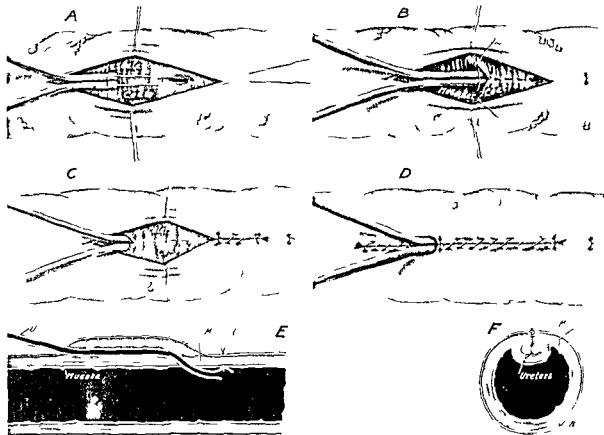


Fig. 1. M t p r t f l t t h l f l t  
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t t g d t t h l m f t t t  
U t h b n h d t h d f d t t  
t t l t t l l l g n f t t l  
t h t C M l l h b m d t l p

t m t f l g h f t h d l n t m l  
l l t l t u D T l m p l t l p t  
l l S l t l l m p l t e d M r t l  
t m l t l m t h d t t t t t  
T l t l l m u l e l l B C d  
D l r w f m M r t l J l f O b t t  
(30)

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c t st p

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the flap ar h l d apart by silk st i o t n ula

4 After making sur t t the bo el i s f c o f f a l  
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rubb tub g make small i c i on thr ough the  
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c n t i m e t r f r m th l e r d of th o l l n u l  
t n P s through th op n n g into th i t i r f  
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b n g on n e d l out imm d i t e l v b e l o the d  
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5 Ele ating the t ur t r s at right gl to th  
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c a t g t o r silk u s i g g e a t a r o t to p n t r a t t  
the mu ou coat of the u t e r s Th u t r v  
th l d p a r a l l e l v th the bow l on the l n l l  
p r t i o n th lo r h a n d l i n g s i l k i m a l e t a u t t h u  
c a u s i g n i n e r s i o n of th d e n u d l s u r f a c i t t h  
bo v l f o a d s t a n c e f 2 c n t i m t e r s and additional  
u t u p a s s e l s e u r g h u r t to the muscl r  
c t of th n t e t n e a s i t r o l l e d i n b y the t e s o n

6 Th ur t v no b u r e d in the m s c l r  
coats f th bow l v o v e r f o l d g h c o t s for a  
f u t h r l s t a n c e of 2 to 3 c e n t m e t r s the i n r s o n  
b e i n g f a c i l i t a t e d b y m a k i n g t e n s i o n th lo r  
s i l k h a n d l i n g s t i n g and s c u r i n g th m to the  
u r e t e s b y f i n e c a t g u t s u t u r e s

7 The peritoneal coat of the bowel is now closed over the ureters to the point where they separate and then below them above that point. This is accomplished by a running inversion stitch of silk. A few additional interrupted sutures of silk or catgut attach the peritoneal coat to the outer coat of the ureters.

8 The ureters should be left protruding into the bowel when practicable at the end of the operation so that the urine after the catheter has been removed will be carried off and discharged at a distance of 1 to 2 centimeters from the point of their entrance into the bowel in order to protect the wound in the mucous membrane from contact with the urine.

While this reference to the catheters had not been mentioned in the description of the operation and the catheters have not been shown in any of Martin's pictures in another place in the paper describing the operation for removal of the bladder the following statement occurs:

At the stage of the operation when I am ready to draw the two ureters into the bowel I would advise placing a rubber ureteral catheter with an end opening into each ureter for a distance of 3 inches the two free ends being temporarily plugged. The two catheters are thrust through the opening in the bowel and as the ureters are guided into the opening by means of the fixation and handling silks the free ends of the catheter should be drawn out through the anus and the plug removed and their free ends placed in separate receptacles. After the ureters are secured the catheter should be fixed to the edge of the anus by two silkworm gut sutures.

He states the principles and purposes of his specific technique as follows:

a The ureters should empty into the bowel in the direction of its long diameter from above downward so that the urine shall be discharged in the direction of the fecal current.

b The ureters are buried in the walls of the rectum for a distance of an inch or more longitudinally so that in the act of defecation the fecal mass will close the caliber of the ureters by its pressure on the mucous membrane and that pressure is exerted from above downward in the direction of the onward flow of urine thereby emptying the ureter by a milking process.

c The ureters are further protected by the muscular coat of the intestine. This is accomplished by surrounding them in their longitudinal course through the intestine to the extent of centimeters by the muscular coat of the bowel. This muscular coat of the bowel in acting from above downward milks the urine downward and holds the ureter closed when the rectum is aiding in defecation. When the contraction and closure due to defecation is over the urine will spurt forth with considerable force acting as a cleanser to the ureters.

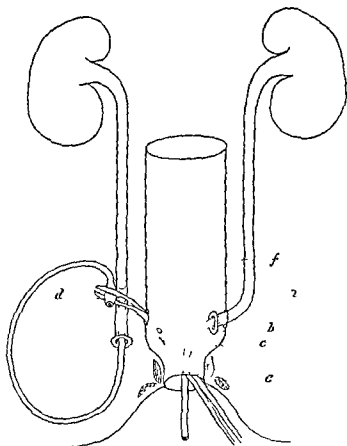


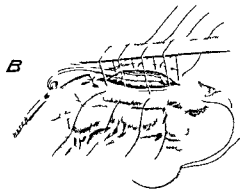
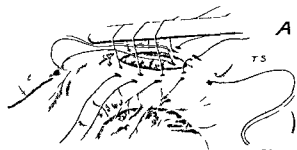
Fig. 3. Peter's operation. Scheme of transplantation of ureter into rectum by extraperitoneal method. 1. Ureter in transplanted position with B to edge of bladder mucous membrane and muscle. C catheter stitched into ureter by suture at B and protruding through F the anus. D forceps passed by the anus through the opening in the bowel and grasping the catheter. I reflection of peritoneum.

While it was Martin's announced intention to produce a valve he in reality produced a sphincter. There is the following difference between a sphincter and a valve:

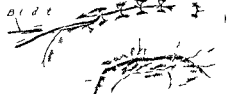
A valve is a non motile movable gate or obstruction which is located at the threshold or in the course of a vessel or tube and which automatically acts to prevent a reflux of matter from an area of greater into one of lesser pressure.

A sphincter is a motile innervated gate or obstruction which is located at the threshold or in the course of a cavity or canal for the purpose of retarding the onward or outward flow for the convenience of the biological or animal mechanism.

A valve is equally active in an animate and in inanimate mechanism. A sphincter is effective only when animated or innervated.



TS



Γ 4 O g l p t f b m u m p l t t  
f t h b l d t d t t t h m l l l g t t  
p t l y D g f b l d t p a t h b

d f m t n l f s b D m b 909 f  
t f m J l f f l M d l t l  
J v 9

In the animal mechanism a valve is found where the activities of vital organs are to be certainly protected. A sphincter is found where function is to be improved. The true valves of the body, such as those which protect the outlet of the ureter into the bladder of the bile duct into the duodenum of the heart into the aorta, function just as well after the patient is dead as during life. A sphincter ceases to function during paralysis or at death. A sphincter is a ring of involuntary muscle fiber under the control of the nervous system and therefore subject to remote reflex or psychological influences as exemplified by such pathological states as cardiospasm, pylorospasm, vaginismus, bladder strangury, and spastic sphincter ani. The true valves of the body contain no muscle

fibers and respond to no influence save that of the force they are intended to control. Martin's technique was not successful because he did not cut the muscular coat and thus eliminate it from the structure of the valve.

The presence of the sphincter of Oddi near the outlet of the bile duct and the extra accumulation of circular muscle fibers near the outlet of the ureter have apparently misled investigators into the belief that these muscles are sphincters for the purpose of preventing reflux while as a matter of fact sphincters are never used for this purpose. It is possible that these circular fibers in both of these instances act like the accelerator urine muscle in the urethra and serve as an accessory force by injecting the bile or urine through the space beneath the valve into

the cavity of the intestine or bladder after which the inanimate flap of mucous membrane acting as a separate structure automatically closes to prevent reflux.

**Peters operation** Practically coincidental with the publication of Fowler's statement in his book and of Martin's work came the publication of a paper by George A. Peters of Toronto under the heading of Transplantation of the Ureters into the Rectum by an Intraperitoneal Method for Exstrophy of the Bladder which was published in the *British Medical Journal* June 22 1901. Peters operation was a modification and an improvement of the M'vdl operation which in reality is not simply a transplantation of the ureter but includes the ureter bearing segment of the bladder into the rectum. Peters description follows:

On July 15 1899 the patient was anesthetized and the parts were disinfected as thoroughly as possible. The sphincter was well stretched and the rectum having been previously cleared by a purge and enema was washed out with an antiseptic solution of non-poisonous strength. A fair sized sponge to which a tape was attached was then passed into the rectum as high up as possible. This not only prevented any passage of fecal matter but assisted materially in raising the anterior wall of the rectum toward the bladder. Turning now to the bladder a Jacques soft rubber catheter (Fig 3 c d) about No. 5 (English) was passed for about 2 inches into each ureter. The part containing the eye was cut off so that the urine entered the opening upon the end of the catheter freely. A silk suture was then caught through the extreme end of the ureteral papilla (Fig 3 b) once or twice and was also passed by a needle through the substance of the catheter so as to effectually prevent its slipping out as it was the intention to retain these catheters in position at least 48 hours. Care was observed not to obstruct the lumen by passing the thread across it or by tying too tightly. The distal end of the ureter with a goodly rosette (Fig 3 b) of bladder muscle and mucous membrane was then dissected free the catheter affording an excellent guide to its position. The idea was that whatever virtue there might be in the peculiar termination of the ureter upon the inner surface of the bladder should be retained when the transplantation was completed. As soon as the entire thickness of the bladder wall (which is here uncovered by peritoneum) has been snipped through with scissors or scalpel blunt dissection may be employed and it will be found not to be difficult to free the lower end of the ureter along the wall of the pelvis without injury to the peritoneum.

Both ureters having been isolated the whole of the bladder tissue was remorselessly ablated from

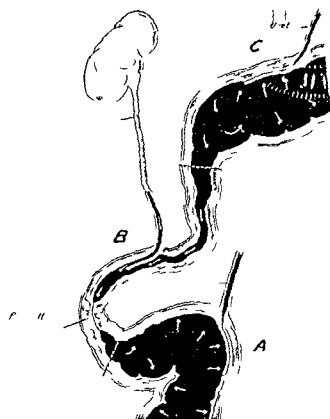


Fig 5 The modus operandi in the delivery of urine into the intestine. A Segment of intestine is lifted out of rectum. B Collapsed intra-intestinal ureter held open, the valve closed. C Collapsed intestine in which ureter has been reduced by the action of peristalsis. Arrows indicate fluid following in the wake of the peristaltic wave. Valve has been opened by the relatively greater pressure in the ureter and the urine is being delivered into the intestine. C After pressure of the peristaltic wave the intestine again assumes a state of rest and the valve is again closed by static intra-intestinal pressure indicated by the arrows.

the perimeter where it merged into the skin to the prostate where the vesiculae seminales debouched. (During this dissection great care must be taken not to expose or injure the peritoneum and if its hazardous proximity be suspected a portion of the bladder muscle may be left though every vestige of its mucous membrane must be removed. In my case the peritoneum gave no trouble whatever and was never in the least jeopardized.)

The next step was to expose the lateral aspects of the rectum at a point below the reflection of the peritoneum (Fig 3 f). The deep dissection was found to be surprisingly easy and by pressing back the retrovesical cellular tissue I was able to expose the anterior and lateral walls of the rectum with readiness. This part of the operation was greatly facilitated by an assistant who inserted his finger into the rectum and lifted it into the wound.

The final step of the operation was the implantation of the ureters into the lateral walls of the rectum and this was accomplished as follows:



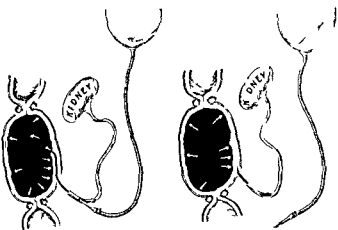


Fig 7 Segment of intestine into which the ureter was implanted 67 days prior to removal of specimen. The pre-sure within the intestine closes the valve by pre-sure on the mucous membrane. Not a drop could be forced back into the duct.

Canadian and English surgeons. By making the operation extraperitoneal supplemented by drainage Peters practically eliminates the danger of serious infection. By transplanting the valve mechanism at the end of the ureter from the bladder into the rectum he has saved the kidney from intra-intestinal pre-sure but he in no way utilizes the fundamental principle of surgical valve formation. Therefore his operation is only applicable to exstrophy of the bladder.

If Fowler had drawn his ureter through a stab wound (indicated by a circle in Figure 1A) in the lower angle of the diamond of mucous membrane instead of in the upper or proximal angle or if Martin or Peters had cut through the circular muscular layer of the intestinal wall down to the mucosa for as much as one half to 1 inch a satisfactory technique would have been evolved by each of these men prior to 1900. They omitted to do this because the problem itself had not yet been isolated and defined.

It would seem that a combination of the Peters technique with the submucous tube technique described later in this article might be the operation of choice for certain cases of exstrophy of the bladder.

#### ISOLATION AND DEFINITION OF THE PROBLEM

The problem itself was discovered by accident as an incident in the course of another line of research.

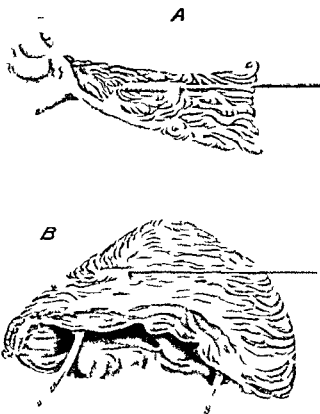
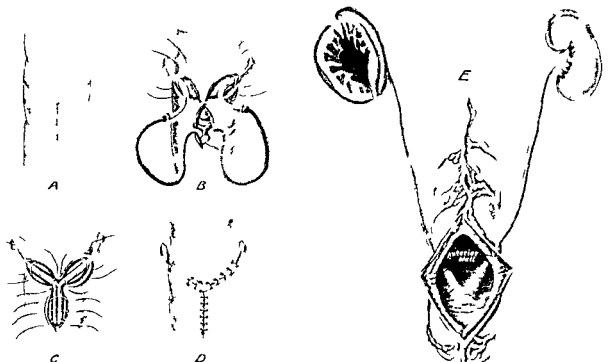


Fig 8 Comparison of surgically produced valve (A) with normal valve in dog's bladder (B).

In 1908 at the suggestion of W J Mayo I took up the study of the problems connected with pancreatic surgery. For this purpose an animal hospital was constructed and specially equipped. In certain experiments on the pancreas it was found necessary to transfer the delivery end of the common bile duct to a location lower down in the intestine as a preliminary step to surgery of the pancreas. Transplantation was done by the direct method which had been recommended by W J Mayo (Fig 6B). When the abdomen was opened for work on the pancreas itself 2 weeks or more after the transplantation I found that the duct in every instance was enormously dilated. In one instance it was practically as large as the duodenum itself. The dilation extended all the way into the lumen of the bowel including the opening in the intestinal wall itself. At once the thought occurred that the intra-intestinal pressure must be greater than the intraductal pre-sure. Hence the dilatation of the unprotected thin-walled duct. The solution must lie in a study of the mechanism used by nature. Therefore



I q B l t l t p l t t f t t t h m  
t t l l l f D t t d l n h l f t l g l  
m h t l g t l n l B l h  
h both t l b g t t a h d t g u

th g l a n g l t b d C T h q f pl  
ut D C m p l t l t l E S y m ed  
f m l d s ft j t (Th p r a t o h a t  
bec ed h m p t t d s n t o m m ded)

the relations of the delivery end of the duct were studied in the living dog. It was found that contrary to the mysterious oblique penetration through a complicated muscular wall which had been taught by some authorities the duct first penetrated the muscle then ran immediately beneath the loose mucous membrane for a distance before it emerged into the lumen of the bowel. The principle was further studied in dogs bladder by the construction and application of a similar arrangement to inanimate rubber tube rubber balls and rubber valves. The solution of the technical problem seemed obvious. The duct must lie under the loose mucous membrane for a distance before it enters the lumen of the intestine.

The first method was to make a stab wound through the muscular layer insinuate the point of a forceps for a distance between the mucosa and muscle spread the forceps to separate these structures then with the point of the forceps puncture the mucosa about an inch farther along insert a grooved director

through this canal pass it for an inch farther on along the inside of the intestine then pass a threaded needle attached to the end of the split duct along the groove and bring the needle out through the intestine about 2 inches below the entrance through the peritoneum and muscle wall. In this way it was hoped to drag the duct through this little canal and anchor it on the inside. This proved to be more difficult than was anticipated and the method was abandoned for a simpler process which consisted of an incision 1 or 1½ inches long through the peritoneal and muscular coats. Through this incision the muscular coat was separated with the handle of a knife from the mucosa. A stab wound was made at the lower end of the exposed mucosa and the duct dragged through this opening by a needle and thread which was attached to the split end of the duct as shown in Figure 4 A. The cut edges of the severed structure of the intestinal wall were drawn together across the duct. This left the duct lying under the mucous membrane in

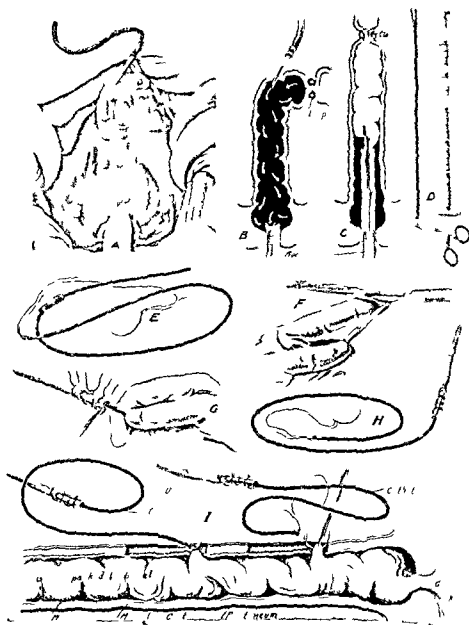


FIG. 10. Preparation of the lower ureters. A. Bowel clamped, needle for irrigation inserted. B. Cross section showing washing out the bowel. C. Jackson catheter with gauze. D. Sigmoidoscope and laryngeal forceps used in packing the gauze. E. No. 12 ureteral catheter cuff of rubber tubing. F. Splitting the ureter. G. Catheter cuff tied into the ureter and tied in place by suture. Note one suture is tied above the cuff. H. Catheter cuff tied in the ureter. I. Showing packed catheter. The function of the gauze in drawing ureters through the wound.

the same relative position to the layers of the intestinal wall as that existing between the delivery end of the duct and intestine in a normal condition.

This operation was performed on 6 dogs under the same circumstances and conditions as were present in the former series of cases of direct implantation. The result was that whereas the ducts were dilated in all cases of direct implantation, no dilatation of the duct

was found in any case in which the space between the mucous coats of the duct and intestine had been obliterated. The problem and its solution had been isolated from a viscus of low pressure.

**Solution.** Production of a specific problem of a secreting organ.

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I l u s t r a t i o n

pressure must be low and regular into a second hollow viscus in which the pressure is high and irregular.

*Specific solution.* The production of a valve from the non motile mucous membrane of the second viscus.

*Specific technique.* Having the duct of the first viscus run between the mucosa and muscularis of the second viscus for a distance before entering its lumen.

*For making an effective.* The peristaltic wave in the second viscus and in the duct itself (Fig. 1).

The results of the experiments on the pancreas incidental to which were the discovery and isolation of the problem involved in the transplantation of the duct into the intestine were presented before the meeting of the Southern Surgical Association in 1909 at Virginia Hot Springs under the title "Pancreatic enterotomy and Pancreatic resection" and printed simultaneously in the jubilee number of the *Annals of Surgery* December 1909. In closing the discussion on this paper I made the suggestion that this same principle might solve the problem of ureteral transplantation.

Immediately after this presentation and publication I began a series of experiments on the ureters using the same principles. The results were reported and specimens exhibited to the Surgical Section of the American Medical Association at St. Louis in June 1910 under the title "Physiological Implantation of the Severed Ureter or Common Bile Duct into the Intestine." Illustrations for the technique adapted to the implantation of the ureters (Fig. 4 B) were submitted and published with the report in the *Journal of the American Medical Association* (1911 Vol. 11). The results of these experiments which were preceded by repetition of bile duct experiments were summarized in the article as follows:

In 5 dogs with direct implantation of the bile duct all specimens showed marked dilatation of the 4 dog in which the lumen was transplanted by the ulmucous method none showed dilatation of the duct. Of 6 dogs in which direct implantation of the ureter was performed 5 died with pyelitis and 1 survived the operation while the sixth lived and was killed 161 days after operation when it was found that the kidney with the implanted ureter had become totally atrophic leaving only a hull of fibrous tissue while the ureter was dilated and remained patent (Fig. 6 C). Thus every ureter and every bile duct which was transplanted directly into the intestine without any formation distal through out its tent including its passage into the intestinal lumen. On the other hand of 9 dogs in which the ureters had been implanted by the ulmucous method 4 had died after operation and 5 from general complications such as pneumonia encountered a very favorable prognosis. The 5 which survived from the immediate effects of the operation showed undamaged kidneys and undilated ureters when the dog was killed at period ranging from 60 to 67 days after operation. Removed specimens when tested showed that the kidney was as perfect mechanically as the distal intestine as well as the lumen. Figure 7 is showing a post mortem experiment which was made in all of the cases so far as this valve in one instance that by using my ent weight and supporting on the obstructed intestine rupture of the bladder occurred without causing a reflux of the fluid through the ureter which had been transplanted. All the other specimens in this series showed similar valve production. Figure 8 shows the similarity of the valve which has been surgically constructed in the course of the ulmucous implantation of the ureters to the normal valve in a dog's bladder.

As far as I know this was the first time that a number of undamaged dog's kidneys



FIG. 1. Traction loops in place for holding bowel while incisions are made. The lower or left incision has been made through the muscularis; the handle of the knife separating the muscle from the mucous membrane.

and been presented before any society following transplantation of the ureters into the bowel. Fortunately, Dr. Charles H. Mayo as chairman of the Surgical Section of the American Medical Association at the time my work was presented. He saw the kidneys and the valves in the intestine produced by the implantation as well as the technique and recognized the importance of the presentation that had been made.

*Dr. Mayo's contribution.* Dr. Mayo's relationship to the development of this operation is very direct. Had it not been for his sound clinical judgment, remarkable skill, and his standing in the profession, it is entirely possible that the completed procedure which we are presenting now might have been delayed for many years. For I must admit that there have been many times when I have been

discouraged with it myself. Dr. Mayo's results always inspired hope and renewed energy.

After I presented this experimental work and the technique described in Figure 4, it was nearly years before I saw a case in practice to which I could apply it. In the meantime, Dr. Mayo had used the operation on two or three cases for exstrophy of the bladder so that to him belongs the credit of being the first to perform this operation on the human. While Dr. Mayo has never claimed to have added any vital point to the technique of the operation, he added the following personal touches which materially helped to clinicalize the procedure. He used fine catgut instead of linen; he left off the control suture at the upper end of the implantation wound; he used curved rubber-covered clamps for hold-

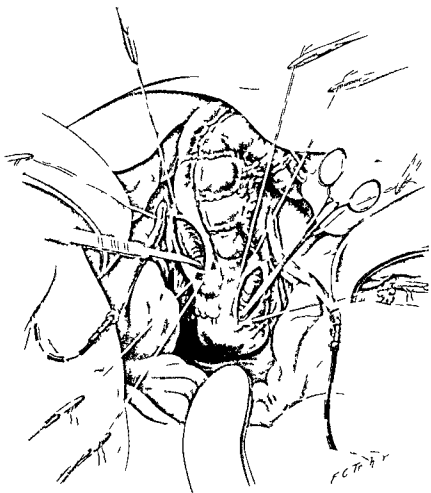


Fig 3 Pig pg u tab w d m a

ing the intestine he supplemented the interrupted sutures with a continuous catgut he called attention to the advantages of implanting the right ureter first low down in the rectum and at the same time fastening the parietal peritoneum to the intestine near the anastomosis 10 days or weeks later he transplanted the left ureter into the sigmoid

In Osler's memorial volume Dr Mayo's article on exstrophy of the bladder sums up his experience at that time

In our series of 52 patients 6 were operated on by the plastic method 1 died 6 months later (traumatic exstrophy at childbirth) 3 patients were operated on by the Maydl-Movshian method of whom 1 died of uremia Twenty six were operated on by the transplantation method 22 successfully 2 of these patients had but one kidney each Four died

shortly after operation Seventeen of the 52 patients were not operated on at the time of their examination some of them were too young and are to be operated on later others with diseased or dilated ureters were advised against the operation

In the *Journal of the American Medical Association* (LXXVII 624) C H Mayo and Walters reported 35 cases operated on between 1911 and 1917 in which the ureters had been transplanted for exstrophy of the bladder with remarkable results (To date Dr Mayo has done the operation on 93 patients)

In addition to Dr Mayo's work Dr W E Lower of Cleveland has performed a number of ureteral transplantations by this first technique I have transplanted something like 14 ureters by the original technique while



Fig. 5 Ureter being anchored in place

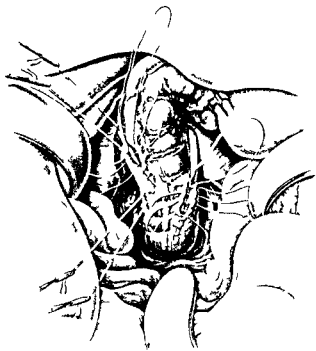


Fig. 16 Ureters inserted in the intestinal wall by sutures

a considerable number of individual operators throughout the country have performed this operation successfully by this method. There has always been a considerable element of danger and difficulty in carrying out the proper technique by this original method. It has also been impossible to transplant both ureters at the same time with any degree of safety probably due to the fact that the edema following the operation seems sufficient to shut off the flow of urine into the intestine for 2 or 3 days and results in a uræmia in addition to the sepsis.

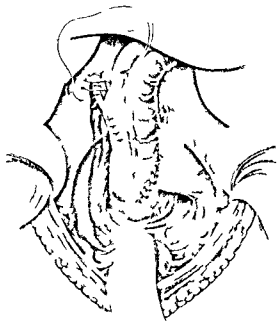
Because of these difficulties and dangers, few have had the temerity to recommend the operation for anything besides exstrophy of the bladder except in rare instances. This has always been very disappointing and I have always hoped that we would be able to develop a technique which would make the operation safe enough to justify its use in many other conditions which occur much more frequently than exstrophy of the bladder.

#### DEVELOPMENT OF THE TUBE METHOD

On January 27, 1925, I was holding a clinic for the Northwest Section of the American College of Surgeons. One of my cases was a

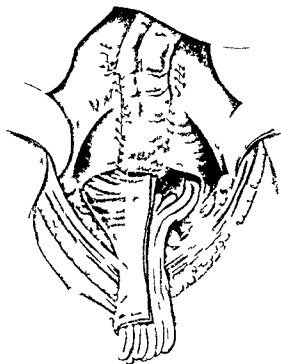
cancer of the bladder for which we were to do a transplantation of one ureter as the first stage of the operation. On opening the abdomen to my great dismay, I found the ureter dilated to the size of a man's finger. The wound was closed and no operation done.

About March 30, another patient was referred to me with a hopeless cancer of the uterus, bladder, and the vesicovaginal septum. The patient had had a great deal of distress and presented a picture of despair. The relatives were informed that the only thing that could be done was to transplant the ureters, after which we might use large doses of radium. To this they consented, and on April 4 the abdomen was opened through the right rectus muscle with the view of transplanting the right ureter. It was found dilated to the size of my little finger. The incision was then enlarged and the left ureter inspected. It was dilated also. The operation was being performed in the presence of a class of senior medical students and while discussing it, I evolved the following plan: Mobilize and sever the ureter, insert a small rubber tube well up into the dilated ureter. Place a strong linen thread around ureter and tube in order to anchor the tube to close ureter against intestinal infection to stran-



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l l t t l r t b k f th t t  
l d t m l f t t t th p t l p t m

gulate ureter and permit of automatic removal of tube later (Tubes and catheters had been used by others before in connection with ureteral transplantation but not in this way and for the same purpose) After the intestinal wound was prepared in the usual way the small tube through a stab wound in the intestinal mucosa could be attached to a rectal tube which had been passed up through the anus Withdrawal of the rectal tube would draw the ureter into the intestinal wound prepared for it The ureter could thus be implanted submucously in the wall of the bowel in the same way as if no tube had been used This was done The patient was not inconvenienced at all by the operation more than is experienced in any other abdominal operation The kidney did not cease to function for a moment in fact it was discharging urine through the tube during the operation and afterward About 7 days after operation the tube came away and the ureter discharged urine into the intestine in a normal way



I g 8 T l ble k l lee j l c d h f  
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t t pl l t th ga th pat t ht d  
D t t d l d t h m l gutt l ha  
t b pl c l t l th d

On April 18 we opened the abdomen on the left side and transplanted the left ureter in the same manner This kidney also began to act at once and there was not the slightest disturbance from either of these operations (For convenience of later reference this case will be designated Case X)

By the use of the tube to transmit the urine through the edematous tissue surrounding the anastomosis the kidney functions just as if the ureter was brought out through a loin wound or through an abdominal wound Therefore it appeared that both ureters might be implanted simultaneously with the same degree of safety that accompanied the implantation of one ureter and there seemed to be no good reason why in certain cases at least the bladder could not be removed and the ureters implanted making a complete operation at one sitting

In the meantime the patient (Case V) whose abdomen we had explored and abandoned as hopeless as far as transplantation of the dilated ureter was concerned continued to suffer severely and insisted that something be done regardless of the risk. It finally occurred that possibly the left ureter might not be dilated so that on February 1, 1925 we opened the abdomen on the left side and found that the left ureter was not dilated. We therefore transplanted the left ureter into the sigmoid by the original submucous implantation technique. In due time the kidney began to deliver its urine into the bowel and worked perfectly. The urine from the right kidney, of course, kept up the continuous distress and strangury in the bladder but we had in mind ligation of the right ureter for the purpose of killing the right kidney or even doing nephrectomy as soon as it could be established that the left kidney was doing full function. In the meantime we had transplanted the ureters in Case X by the tube method so that instead of killing the right kidney as planned we again opened the abdomen on the right side and transplanted the right ureter by the tube method on April 14, 1925 (Case X). The patient was immediately relieved of his bladder distress. We used some large doses of radium in the open bladder to destroy the local growth if possible. Finally the patient was discharged. He was secreting urine perfectly and was able to hold it as long as 6 hours. When last heard from 8 months after operation he was still quite comfortable although his growth was gradually depleting him. From this time on we were unable to trace him as he had moved to eastern Canada.

After the transplantation of the second ureter in Case X in which the tubes were used a large dose of radium was used in the vagina for the purpose of destroying the foul odor. About weeks after the last transplantation an abscess developed in the abdominal incision through which the left or second ureter had been transplanted. The abscess was large and sepsis was considerable. The patient died of exhaustion about 6 weeks after the second transplantation. Clear urine was discharged through the rectum up to the time of the death of the patient. A postmortem

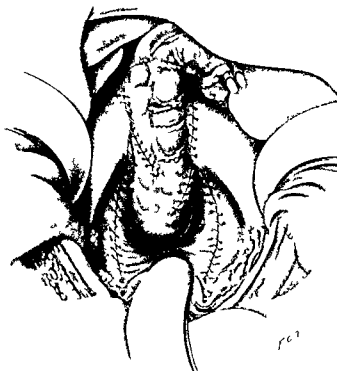
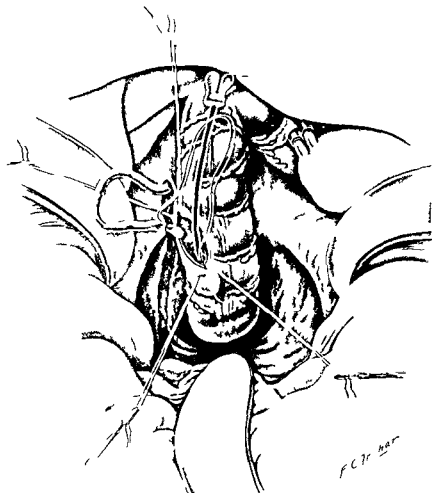


FIG. 19 Completed operation without drainage

examination showed the right kidney to be in splendid condition. The left kidney was filled with multiple abscesses which seemed to have extended up the ureter from the abscess which evidently emanated from the site of transplantation.

#### EXPERIMENTAL SURGERY

The result of this postmortem examination sharply brought out the fact that there were other problems yet to be solved, not the least of which was local sepsis emanating from the site of implantation. Plans were therefore carried out for doing experimental surgery on a larger scale than we had hitherto done. Space was procured in connection with the University of Oregon Medical School. In order to guard against every fault in technique my full surgical operating team was brought into the work. The most pressing problem to be solved was that of cleansing the lower bowel in order to free the field from sepsis as far as possible. A plan was decided upon. The lower bowel must be isolated. Accordingly, rubber covered stomach clamps were placed across the sigmoid above the field of operation. A large needle (No. 13 Lewishon



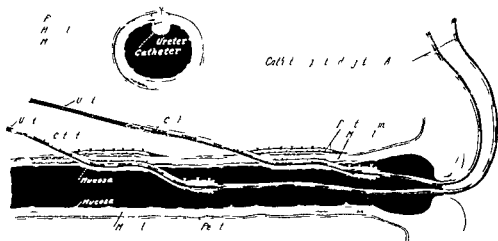


FIG. 21. Scheme of bilateral transplantation of ureters into large intestine. Sectional views.

amount of success followed their use but they were never a complete success. The ordinary ureteral catheter was difficult to hold in place and its caliber became obstructed very frequently by incrustation within the lumen. Therefore a search for larger sized ureteral catheters was made. Finally it was found that C. L. Bard and Company of New York made ureteral catheters of sizes as large as No. 12 but owing to the smooth surface of such a catheter there was no way to anchor the ureter to the catheter. Therefore a small cuff of soft rubber tubing was slipped over the catheter and fastened by a ligature or two making a perfect anchor. After we had solved all these problems the results upon dogs were much better than we had had before.

One very interesting experiment was made in the way of bringing the ureter diagonally forward on each side of the rectum in a diagonal slit. The two slits came together at a point on the front of the rectum. From this point of convergence a single slit was made an inch or more down the front surface of the rectum. Finally a stab wound was made at the lower end of this anterior incision and the tubes and ureters drawn through a single stab wound (Figs. 9 A, B, C and D). This was a very convenient operation and the experimental results were very good (Fig. 9 E). It is barely possible that this operation may have merit but we have not so far done it on the human being.

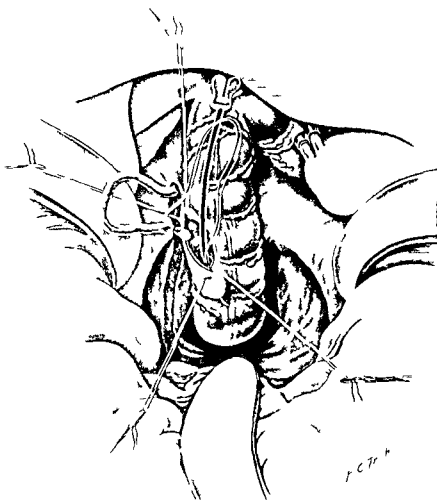
Many other details were worked out until a very definite and workable technique had

been completed. Our experiments showed very clearly that the tube technique not only carries a lower mortality but also gives better functional results afterward than the original transplantation without the tube. However the principal superiority of the tube method is that both ureters may be transplanted at the same operation. The final results of the operation on dogs were not tested out by me but an article published in the May, 1928 issue of the *Journal of Urology* by Charles Morgan McKenna of Chicago supplied the missing link. I have his permission to quote from his article.

I thought it would be desirable and valuable to make some experimental investigation with a view of ascertaining what such kidney function pathology and bacteriology may be following ureteral transplantation. For this purpose we have operated on 14 dogs and 1 human being using the Coffey (tube) technique.

The work of ureteral transplantation was started in October, 1915. The first 5 dogs operated on died with one exception. At autopsy the same pathological condition was found in each dog. Death was not due to the Coffey technique but to our own fault in carrying it out. In these dogs we failed to draw the ureter far enough into the lumen of the bowel and secondly there was too much tension on the ureter, the result being a suppuration at the site of transplantation into the bowel and hence an ascending infection into the kidney producing an acute pyelitis and general peritonitis. Perfecting the technique by taking away all tension from the ureter after transplantation and introducing the ureter far enough into the bowel produced results and we showed that the urine emptied freely into the lumen of the bowel. The dogs made a good recovery from the operation and were allowed to go



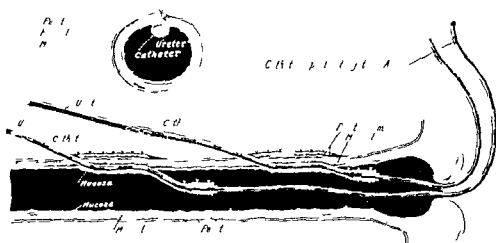


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transfusion needle) was procured and attached to the tube of an irrigator. A sigmoidoscope was inserted into the rectum the water turned on in a large stream and allowed to run until the water came clear through the sigmoidoscope. All the water was then drained out through the sigmoidoscope and the obturator was reinserted and the instrument passed up to a point near the clamp obstruction. With long laryngeal forceps gauze strips were picked into the gut through the sigmoidoscope until the rectum appeared stuffed. This was a great improvement as the gauze not only

made the intestine easy to handle but absorbed all the moisture inside the intestine. Furthermore the ureteral tubes could be attached to the gauze instead of the rectal tube.

The next obstacle that was encountered was spasm of the dog's ureter which made it very difficult to introduce a soft tube of sufficient size to carry the urine for more than a day or two. Every type and variety of tubing was tried. Finally silver tubes and gold tubes were constructed to which the rubber tube might be coupled. A certain



I 1 Scheme of bilateral transplantation of ureter tube technique Sectional view

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capsule. The right kidney was enlarged, the ureter thickened and marked hydronephrosis was present. No scars were present. The ureter was patent and a probe could be passed from the ureter into the bladder. There is no explanation for the hydronephrosis on the unanastomosed side unless pelvic infection secondary to operation caused a peritonitis. Dogs 8, 9 and 10 were operated upon December 9, 11 and 13, 1935 respectively, the Coffey technique as previously described being used.

On February 8, 1937, 1 year and 2 months after operation, these 3 dogs were anesthetized in the same manner as Dogs 5, 6 and 7. The right ureter which had been transplanted in the previous operation was isolated and a double ureteral catheterization was done by making a small slit in each ureter. A kidney function test was done, 1 cubic centimeter of phenolsulphonephthalein being used with the following results:

**Dog 8.** The dye appeared on the good side in 3 1/2 minutes and on the right or transplanted side in 4 minutes. The function on the left side was 2 per cent in 15 minutes while on the right it was 18 per cent. Bacteriology was negative on both sides.

**Dog 9.** The dye appeared on the left side in 3 1/2 minutes and on the right or transplanted side in 4 minutes. Function was equal on both sides, 21 per cent in 15 minutes. The urine was negative on both sides.

**Dog 10.** The right ureter was found to be slightly larger than the left. The right was the transplanted side. In the dye test the dye appeared on the left side in 3 1/2 minutes and on the right side in 6 minutes. Laboratory analysis showed colon bacillus in the urine from the transplanted side and sterile urine on the left side.

In this case the transplant was made into the bladder instead of into the bowel. Hydro-ureter and hydronephrosis were marked, especially the hydro-ureter. This was due to a constriction of the ureter at the place where the transplantation into the bladder was made. We tried to use the technique as in the bowel but apparently the bladder does not work with the same valve like mechanism. In other cases where we made a transplantation into the bladder we found we were inclined to get a hydro-ureter which proves pretty conclusively that the Coffey technique is the one of choice in the bowel.

Those who have had experience with transplantation of ureters in dogs will appreciate the remarkable success of Dr. McKenna in which he has had 5 consecutive ureteral transplantations in dogs in which the animal lived more than a year and in which practically normal functional results were obtained. I, a very surgeon who has had both experimental and clinical experience realizes how much more difficult it is to get results in the case of a dog than in the human. The dog seems to

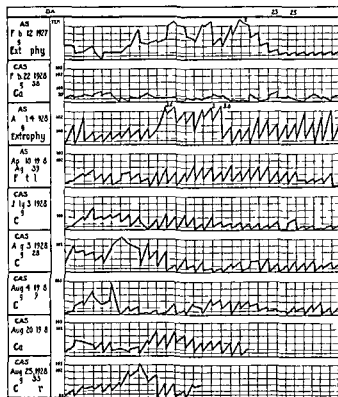


Fig. 23. Comparative temperature chart for all cases.

have poor resistance to colonic bacteria and this particular operation is far more fatal in the dog than in the human.

#### TECHNIQUE

It goes without saying that the fundamental proposition forming the background of any successful technique for transplantation of the ureters into the bowel is that valve action must be produced. A valve to be always effective must be unanimated and uninfluenced by muscular structures. The mucous membrane is the only available structure meeting this requirement and is the one which has been universally used by nature for such a purpose. The fundamental point in the technique is that the ureter must be made to run immediately under the mucosa for a distance before it opens into the lumen of the bowel.

The two other important features to remember are:

A. The kidneys are vital organs and life can last only a short time without their function. Therefore the operation must be so arranged as to interrupt renal function as little as possible. After every wound an

exudation which produces a certain amount of swelling takes place in the neighborhood of the wound. It seems that when a ureter is transplanted the swelling in the wall at least in certain instances temporarily retards or completely blocks the flow of urine from that kidney. If both ureters have been transplanted without the provision for the free passage of urine the patient will often die from uræmia. Sometimes the swelling does not obstruct the ureter but it is generally concluded that bilateral transplantation of ureter without the provision is very dangerous. To provide a unit the serious interruption of renal function during the days immediately after operation three plans have been used.

1. Transplantation of one ureter at a time through separate incision the operations being from today to week apart.

Unilateral or bilateral transplantation of ureter preceded sometime before by bilateral nephrostomy.

The tube or catheter technique in which catheter of sufficient size are used to transfer the fluid through the operative field during convalescence.

By the first plan two major abdominal operations are necessary. By the second plan two minor incisions are made at one time followed later by an abdominal operation. By the third plan the tube or catheter technique only one operation is required and only one abdominal incision.

B. The operation must be done in an aseptic field. Infection emanating from the site of transplantation is often fatal and is always detrimental to the final result. Therefore every effort to sterilize the field and produce an aseptic operation should be made. The plan for bringing about an aseptic field is equally applicable in each of the three plans.

There will be times when each of these plans will have its advantages. Plan 1 using the type of technique described in St. Louis 1910 (Fig. 4 B) might be made necessary because of the smallness of the ureter, the inability to secure proper tubes or catheters, or in an emergency in which a ureter has been injured. Plan (Hinman's) will be indicated

when the ureters are too much dilated to permit of transplantation into the bowel in which case a bilateral nephrostomy combined with ureteral catheter in the ureters would permit the ureters to become reduced in size and also permit the infection to be cleared out by irrigation. The transplantation operation to be done later at an opportune time. It might also be indicated in substandard patients or in cases in which an obstruction at the neck of the bladder has temporarily damaged the kidneys. Plan 3 should be used as a routine procedure except for the special indication already enumerated.

Assuming that the operation is to be done on Saturday an ounce of castor oil is given on Thursday and again on Friday morning. On Friday evening and again early Saturday morning the bowel is flushed with a high enema of clear water. A light diet is given on Friday and the patient is induced to drink all the water possible. At 7:00 a.m. Saturday

4 grains of morphine and 1/150 grain of atropine are administered and a rectal tube is placed in the rectum to carry off any fluid which may come down. A general anæsthetic is started at 8:00 a.m. An incision extending from just above the umbilicus to the pubic bone is made just to the left of the middle of the abdomen. All the intestine except the sigmoid are carefully packed back and held above the promontory of the sacrum with a 5 yard pack of gauze. A thin bladed curved rubber covered stomach clamp is now placed on the sigmoid 1 to 14 inches above the anus thus isolating this lower segment.

The patient is now drawn down to the end of the table so that the buttocks protrude beyond the table. A skilled assistant inserts a sigmoidoscope 30 centimeters long into the rectum and on into the sigmoid guided by the operator's left hand manipulating within the abdomen. A tube 2 feet long in which has been fastened a beveled edged needle (No. 13 Lewishon transfusion needle) is coupled to the tube of an irrigator which is arranged at considerable height. The needle is thrust through the wall of the sigmoid just below the clamp and the water is turned on. The sigmoidoscope is drawn down so that the end is within an inch or of the anus.

The water when it begins to flow through the sigmoidoscope usually contains small particles of faecal matter and mucous. As soon as this is entirely clear 500 cubic centimeters of a 1 per cent solution of mercurochrome is put in the irrigator (as suggested by Dr L. L. McArthur of Chicago, in a personal communication). After the irrigation is finished and the fluid has entirely drained away through the sigmoidoscope the obturator is again inserted and the sigmoidoscope under the guidance of the operator's hand within the abdomen is pushed upward to within an inch of the obstructing clamp. Sterilized gauze packing folded from a strip of gauze 4 inches wide and extending to a length of about 10 feet is now used to pack the lower bowel. For this purpose a laryngeal forceps with a straight shaft of somewhat more than 30 centimeters is used. As the assistant from below introduces the gauze with forceps the placing of the gauze is guided by the operator's left hand within the abdomen. As the bowel is filled with gauze the sigmoidoscope is gradually withdrawn. The assistant is carefully instructed to include a considerable mass of gauze in his forceps so as to prevent the end of the forceps from injuring or penetrating the intestinal wall (Fig 10). After the segment of bowel from the clamp downward has been filled with sterile gauze the patient is drawn back on the table and placed in a moderate Trendelenburg position.

The posterior parietal peritoneum is now incised over the most convenient approach to one ureter. Through this incision the ureter is located and picked up on a smooth retractor. The incision is extended both ways as much as needed to expose the field. The finger curved under the ureter is slipped down like a hook toward the bladder freeing the ureter of its connective tissue and pushing down the structures of the broad ligament in a woman to a point as near its entrance in the bladder as possible. Under the guidance of the left index finger used as a hook, a small Kocher clamp is placed on the ureter. Another is placed just proximal to it. The ureter is now severed with a knife (Fig 11). The distal stub of ureter is tied with catgut just below the forceps. If no drainage is to be

used the stump should be cauterized with carbolic acid. The other ureter is lifted in like manner and the two clamped ureters are drawn through the upper end of the wound. If drainage is to be used (and my personal opinion is that it is safer particularly for one doing his first operation of this kind) gauze is packed into and over these slits in the peritoneum while the further steps of the operation proceed. (In order to keep the steps all clear the peritoneal slits have been left exposed in the illustrations.)

Two No. 12 whistle tip ureteral catheters have been sterilized and prepared by fastening a cuff of rubber tubing on the catheter about 6 or 7 inches from its tip. At the other end of the catheter is fastened a double linen thread armed with a round needle to be used in fastening the end of the catheter to the gauze within the rectum. The end of one of the catheters has been sloped for identification. The clamp holding the ureter is taken in the left hand while a knife in the right hand splits the anterior wall of the ureter. A catheter is now inserted into the first ureter down to the rubber cuff. Two strong double linen ligatures are now tied around the slit portion of the ureter and around the anchor cuff. A third strong linen suture is placed around the ureter above the cuff for the double purpose of completely shutting the intestinal contents off from the ureteral canal and of furnishing strangulation of the ureter at this point so as to form a line of separation later (Fig 10).

Attention is next turned to the intestinal part of the operation. The lowest point in the sigmoid at which the operation can be conveniently done is to be considered the site of election. Using two incisions I have found it more convenient to transplant the left ureter in the lower incision. The lower end of the upper or right incision should be at a higher level on the intestine than the upper end of the lower or left incision. The incisions are made diagonally about an inch and a half in length extending from the mesentery's edge downward and toward the midline of the intestine. While on dogs I have successfully and easily performed the operation in which the incisions were made on the same level and the

ureters brought out through a single opening (Fig. 9) and while Charles Morgan McKenna of Chicago experimentally and Herbert Coe of Seattle clinically have transplanted both ureters through a single longitudinal incision with separate stab wound in the mucosa for each of the two ureters. I think two separate incisions at different levels is possibly the best plan. Using this plan two traction loops of No. 0 catgut in which both ends are left long are placed at each end of the proposed incision about 1 inch apart and including the muscular coat of the bowel also including any nearby vessels which cross the incision and which might bleed during the operation.

With traction loops made taut the surgeon with a fine bladed knife carefully makes each incision through the peritoneal and muscular coat. With the handle of the knife the muscular coat is pushed off the mucosa (Fig. 10). The ureter is now placed between the two upper traction loops of each excision. With a fine sharp pointed knife a small stab wound is made through the mucosa at the lower angle of the incision. A very fine Halsted mosquito forcep is thrust through this tiny opening where it seizes a bite of gauze within the intestine (Fig. 13) and pulls a small bit of the gauze through this puncture. To the gauze in the two wound the two catheters are sewed (Fig. 14 frontispiece). It is important at this juncture to determine and record which ureter contains the catheter with the sloping edge.

At this point the nurse begins to withdraw the gauze from the anus. As the gauze begins to tug on the lower catheter the surgeon carefully guide the end into the bowel. The gauze is pulled down until the end of the lower catheter comes through the anus. Then the pull is made on the catheter. When the end of the ureter around the cuff approaches the wound it is sometimes necessary to dilate the opening in the mucosa slightly so as to permit the ureter to enter the bowel. After it is pulled down comfortably taut the nurse again pulls on the gauze until the end of the other catheter approaches the opening. This catheter is pulled down in the same way as the first one. At this point it is just as well to remove the remainder of the gauze because

it may be inadvertently picked up by a suture and may make trouble in pulling it out later.

With the ureters lying comfortably in their relative incisions the two traction suture at the lower angle of the lower incision are made taut. A fine curved needle threaded with No. 000 chromic catgut double thread is passed through the peritoneum and musculature of one side of the incision and picks up a good bite of the ureteral wall then the other side of the intestinal wall thus fixing the ureter in the lower end of the wound (Fig. 15). It is probably well to use two sutures which take a bite of the ureter. The sutures are usually tied as they are placed rather than all left loose as shown in the illustrations. The other sutures pick up the intestinal wall just outside of the incision and roll the edges in over the ureter. These may be of No. 0 catgut. The traction loops may now be cut or tied together and another line of sutures either continuous or interrupted may be used to cover in the first line (Fig. 16). The ureters after the operation is complete should be covered in by peritoneum and not left exposed to the intestines.

If drainage is to be used a continuous suture begins to bring the edges of the peritoneal incision together just above the ureter. After the second or third stitch the inner edge of the peritoneum is dropped and the outer edge is drawn over to the side of the intestine where it is sutured and from which point the continuous suture follows the intestine downward partially covering the line of suture. As it approaches the lower end it turns outward toward the inner cut edge. This leaves a retroperitoneal space through which any infection that may emanate from the line of sutures may travel downward to a drain (Fig. 17). The lower part of the incision is left open. The four ends of two double wicks are placed in the lower angle of each peritoneal incision. Two more double wicks are placed in the cul de sac. Two folded sheets of gutta serena tissue cover in the gauze so that no intestine can touch it and the wound is closed leaving this quarantine pack coming from the lower end of the incision (Fig. 18). One week after the operation the gauze wicks

are carefully and separately withdrawn 4 to 7 days later the gutta percha is removed and the wound is allowed to heal of its own accord

The method of construction of this quarantine drainage is described in *Annals of Surgery* June 1917. Some of course may prefer simple rubber tissue drains some tube drains. Because of the danger of intestinal obstruction around such a drain however I think it is better to use no drainage at all than to use anything except the quarantine which I have described. This method of quarantine drainage makes the operation very safe. Undoubtedly many operators will prefer to do the operation without drainage. If the abdomen is to be opened later for such operation as removal of the bladder it would be more convenient to have no drainage at the transplantation operation.

At the end of the operation a fold of parietal peritoneum is drawn over the ureter to the intestine (Fig. 19).

There will be times when proper tubes may not be available or when for other reasons it will be necessary to transplant the ureter without a tube. In such cases the same method of cleansing the bowel which has been described for the tube technique will be equally applicable. The dangers and difficulties which were experienced in the past in connection with unilateral transplantation without the tubes will be greatly abated. The same technique as has been described for the transplantation by the tube technique will be applicable except that the end of the ureter must be fixed by a suture to the inner side of the intestine distal to the wound of entrance. In order to avoid the embarrassment of picking up the gauze within the intestine on the needle carrying the anchor suture a grooved director is passed through the stab wound and its point made to lift up the wall of the bowel. A curved needle carrying the anchor suture is then passed along the grooved director where its point punctures the intestine. The needle is then drawn through and by pulling on the thread one can drain the end of the ureter inside the intestine. By picking up a bite of the intestine near the place where the anchor suture has

come through one may tie a knot so as to anchor the split end of the ureter in place (Fig. 20). The sutures are then placed by the same technique that has been described for the tube technique.

#### POSTOPERATIVE COURSE

During the progress of the operation subpectoral infusion of normal salt solution is given for the purpose of increasing the flow of urine as well as supporting the patient. Sometimes the urine discharges throughout the course of the operation. On the other hand it is sometimes 3 or 4 hours or even longer after the operation before the urinedischarges in any amount. The ends of the catheters are covered with absorbent cotton which is fastened on them with adhesive plaster. As soon as both catheters begin to discharge freely the covered ends are kept in a urinary which has been sterilized. While the operation is as a rule unusually free from shock it is a fact worthy of note that the pulse in most cases has been fairly rapid for a few days. Subpectoral infusions are used freely for the double purpose of sustaining the patient and increasing the output of urine.

Occasionally a little blood appears in the urine of a kidney and in one instance a little clot formed in the catheter but was easily sucked out by aspiration. Hinman has suggested washing out the catheter with per cent boric acid solution to keep the opening clear. In one instance a catheter stopped running because of incrustation of urinary deposits inside the catheter. By cutting off an inch or 2 of the catheter the urine started again. If the operation has been in a child for ectrophy of the bladder and the tube has been smaller than No. 8 and becomes obstructed it may be necessary to put in a speculum under anesthesia and to cut the catheter loose from the ends of the ureters. This was done on the fourth day in Case 1 of this series. This procedure was first carried out on one of my cases by my former associate Dr. Wayne J. Stater who later wrote of it in the *North-east Medicine*.

If the ureters are dilated and oedematous the catheters sometimes come away as early as



the fifth day. If the ureters are relatively normal in structure they remain longer and come away between the eighth to sixteenth day.

If urine stops flowing through a No. 12 catheter it will usually be found that the ureter inside the rectum is beginning to slough and leak. The tube is then ready to come out. An interesting fact has developed in this connection. The part of the ureter which protrudes into the intestinal lumen dies back to the mucosa and when the tubes have remained more than 8 days all that portion of the ureter within the intestine comes away with the tube. Figure 22 shows the typical appearance of the two tubes and the piece of ureter that they bring with them. The long piece came from the right or upper ureter. In this case the ureters were dilated and very thin at the time of operation. They came away 5 days after the operation at least one ureter first leaking into the bowel which led to the removal of the tubes at this time. The right ureter pulled out with difficulty possibly too much traction was made on it. At the upper end will be noticed a small strip of tissue which is probably a piece of ureter which pulled out of the side. Leakage of urine followed at this point. It is probable that this ureter was still intact and that the tube was simply obstructed.

My associate Dr. Paul E. Spangler has recently braided a small bulb on the end of a piano wire which he can push down the catheter so as to remove obstruction of any kind. With this wire the catheter may be kept open. The wire cannot be pushed through the whistle tip opening and yet it completely cleans the lumen (Fig. C).

In only one case was the ureter cut off by the isolation ligature which was put on for that purpose. Almost every patient had a distinct rise in temperature about the time the tubes came away sometimes lasting for 2 or 3 days. Twice slight chills occurred at this time with fever. In two instances pain was noted in one kidney while the tubes were in despite the fact that the kidney was discharging clear urine. In both instances this passed off without any serious consequences. In one instance Case in which an assistant

punctured the right side of the sigmoid with the sigmoidoscope a certain amount of local infection took place. In this case quite a severe and prolonged fever followed after the tenth day with definite pain in the region of the right kidney. This was thought to have been due to an infection in the neighborhood of the right implantation which was made near the point where the puncture had been sutured. After the beginning of the third week the patients recuperate very rapidly and so far we have had no evidence at all of late involvement of the kidney.

**CASE 1.** A baby boy, 20 months old referred by Dr. John Hoyt of Spokane, Washington had exstrophy of the bladder with small ulcers over the exposed mucosa. He had a temperature of 100 degrees on admission to the hospital. Bilateral transplantation of the ureters was carried out on February 12, 1927. No. 8 whistle tip ureteral catheters being used. The ureters were dilated and thickened. A small rubber tissue drain was placed in the lower angle of the wound outside of the peritoneum. On the fourth day after operation the flow from the catheters ceased. After the patient had been given an anesthetic the catheters were cut loose from their anchors. Definite ridges and nipple like protrusions marked the opening from the two ureters. On the eighth day after operation the patient began to develop fever. On the twelfth postoperative day the fever was very high and lasted for about 5 days then gradually diminished. No further trouble was noticed. The last report 1 year after operation showed that the patient had not had any trouble as a result of the operation and was in perfect health.

**CASE 2.** A female, age 38 years, had a hopelessly incurable carcinoma of the vagina and bladder which originated in the cervix. Bilateral transplantation of the ureters was carried out on February 22, 1928. No. 10 catheters were used. These were removed on the tenth postoperative day. A piece of dead ureter coming with each tube. The bladder was entirely relieved and the kidneys functioned perfectly. They were delivering urine into the rectum without distress 6 months after operation although the growth was constantly spreading in the broad ligaments in spite of the heavy doses of radium which were used.

**CASE 3.** On April 4, 1928, a 15 year old boy was operated upon at the Doernbecher Hospital, Portland, Oregon, in association with Dr. W. H. Buermann for exstrophy of the bladder. No. 1 ureteral catheters were used. The rectum was accidentally punctured by the sigmoidoscope and the wound was sutured within the abdomen. Transplantation of the right ureter was made above the puncture. That of the left ureter below the puncture. The patient did well until the tenth day. On the eleventh

day his temperature rose and the catheters were removed. The temperature continued intermittently for 3 weeks or more and was accompanied by pain in the right kidney. This finally subsided and the boy was in perfect health as far as could be determined. Five months after the operation the child was reported as being entirely well and attending school.

CASE 4. A female 39 years of age referred by Dr A. F. Walter Kresse of Medford, Oregon, had an incurable vesicovaginal fistula after many operations attempted for relief. Bilateral transplantation was carried out on April 10, 1928. The bladder was found to consist chiefly of scar tissue. No 12 ureteral catheters were used. The ureters were thin and dilated to the size of a small finger. The left catheter came away on the fifth postoperative day; the right began to close on the sixth postoperative day. After the end of the catheter had been cut off the urine began to flow. The catheter was again cut off on the seventh day. On the eighth day leakage began around it. The catheter and an inch of dead ureter came away on the tenth day. Patient was entirely well 5 months after operation with no inconvenience from the urine in the rectum.

CASE 5. A female 54 years of age had a recurrent carcinoma of the bladder following fulguration and radium treatment a year before. Bilateral transplantation of the ureters was carried out on July 3, 1928. No 12 catheters were used and both were removed on the twelfth day. Recovery was uneventful. The patient was entirely comfortable with urine discharging into the rectum. Total cystectomy, September 3, 1928.

CASE 6. A male 28 years of age referred by Dr John G. Cheatham of Portland, Oregon, had an advanced carcinoma of the bladder and was in a serious condition. Hemoglobin was only 36 per cent and 3 blood transfusions were necessary during the course of the patient's stay in the hospital. The cancer was so far advanced that the case was pronounced as hopeless. The bladder had been opened 2 months before to give temporary relief from pain. The cancer mass was sloughing and was very offensive. Bilateral transplantation was carried out on August 3, 1928. Both ureters were dilated. No 12 ureteral catheters were used and a quarantine drain was placed at the lower angle of the wound. The ureters were blocked on the fifth day. The left ureter loosened on the fifth day and the right ureter also was apparently leaking. The left catheter came away easily but the right catheter required some force; a small irregular piece of ureter coming away with the catheter. Leakage resulted above the transplantation and did not entirely heal. Heavy doses of radium were used in the bladder and at present the patient is up and rapidly improving in general health.

CASE 7. A male 49 years of age referred by Dr J. T. Whitby of Seattle, Washington, had an advanced carcinoma of the bladder which had been removed at one time and treated by fulguration several times. On August 4, 1928, bilateral trans-

plantation of the ureters was carried out and No. 12 catheters were used. The bladder was found to be filled with a cancerous mass. The ureters were large and thick. Along the right ureter were very large metastatic glands both in the pelvis and above the psoas muscle. The patient made an uninterrupted recovery and has had radium treatment for the cancer of the bladder, although the metastatic glands make the case hopeless as far as cure is concerned. The catheters worked perfectly and came away without force on the sixteenth postoperative day. No discomfort results from urine in the rectum. The patient is entirely comfortable and is gaining rapidly.

CASE 8. A female 54 years old referred by Dr Charles C. Kehl of Seattle, Washington, had a carcinoma of the bladder which had been treated a number of times with fulguration and finally abandoned as hopeless. Bilateral transplantation with the use of No. 12 catheters was carried out on August 20, 1928. The ureters were thick and somewhat dilated. Extensive involvement of the lymphatic glands along the course of the ureters was noted both in the pelvis and above the psoas muscle. I was informed by Dr Kehl that the original growth was principally on the right side. Both catheters were removed on the eleventh postoperative day as shown by the temperature chart. No evidence of infection of any kind was found. The patient made an uninterrupted recovery with little distress.

CASE 9. A female 33 years of age referred by Dr W. E. Cass of Vancouver, Washington, had been given large doses of radium for an advanced cancer of the cervix and bladder. This had been followed by the formation of a vesicovaginal fistula and great distortion of the bladder by scar tissue. The bladder was very painful and had no capacity whatever. Bilateral transplantation of the ureters was carried out on August 25, 1928. No 12 whistle tip ureteral catheters were used. The right ureter was dilated to the size of a man's little finger and the wall was very thin. The left ureter was slightly dilated and thick. The patient was given a blood transfusion of 700 cubic centimeters following the operation. On the ninth postoperative day the right catheter was blocked by incrustation. This was relieved by a bulb pointed stylet which was devised by Dr Paul E. Spangler and which was made by braising a bulb on a piano wire (Fig. 22 C). The left catheter was removed on the eighth postoperative day. The right catheter came away of itself on the thirteenth day.

The temperature chart of the 9 cases (Fig. 24) shows the temperature for 30 days. Only 1 patient (Case 3) had fever after that time.

## RÉSUMÉ

The valve principle is a fundamental necessity in the transmission of fluid at a given

temperature from a chamber of low pressure into one of higher pressure. A true automatic valve must be non motile and yet movable. The valves of the heart in the veins at the outlet of the ureter and at the outlet of the bile duct are true automatic valves. The muscular development near the outlet of the bile duct and the ureter has no control over the valves. The muscular structure along the wall of the duct and at its outlet probably regulates and accelerates the intermittent flow of bile or urine through the automatic valve and into the receiving viscus. The valve automatically closes in order to prevent reflux during the intermission of the delivery of fluid.

Intra intestinal pressure varies in relation to intestinal peristalsis being reduced in the wake of a peristaltic wave. This reduction of pressure facilitates the delivery of fluid through a duct emptying into this tract.

Isolated instances of successful transplantation of ureter into the large bowel have been reported in the literature from time to time since the beginning of modern surgery. There is no one way of accounting for these successes inasmuch as few postmortem examinations if any have been held on successful cases. A certain amount of untimed success followed the Maydl operation improved by Moynihan's modification also the Peters operation. In these cases the ureter bearing area of the bladder with the valve mechanism was transplanted with the ureter. A review of the literature in the Surgeon General's Library in 1910 showed approximately 250 articles dealing with experimental attempts to transplant the ureters. In no instance was there scientific evidence to show that success had been attained.

The experimentation by Franklin H. Martin was the most important that had been done. He actually approached and almost solved the problem. He devised a good technique but missed the goal of his ambition by failing to differentiate and separate the function of a sphincter from that of a valve. Clinically Fowler had actually made a valve but failed to recognize it and therefore failed to elaborate it because the problem itself had not yet been isolated and defined.

The problem itself is to deliver fluid from a duct of an organ which works under low pressure into a receptacle where the pressure is higher. This problem was discovered in 1909 when it was found that a bile duct always dilated when transplanted into the duodenum without valve protection whereas such transplanted duct did not dilate when protected by a valve. The principles and the technique used in the transplantation of the bile duct were adapted to the transplantation of the ureter into the large intestine with the result that in 1910 5 undamaged dog kidneys and undilated ureters in which transplantation had been done at varying periods of 60 to 167 days prior to removal of the specimens were presented to the surgical section of the American Medical Association along with a definite technique. Dr. Charles Mayo who was chairman of the section recognized the importance of the presentation and was the first to adopt the principles and apply them to a human patient. The published record of his work set forth in papers dealing with his results on this subject marks a new era in urological surgery. These records show that with great regularity and with relatively low mortality when compared with former statistics he has been successful in transplanting the ureters at separate operations in children with exstrophy of the bladder and further more that these children grow and develop to maturity in a normal manner with relatively no evidence of late kidney damage. In other words he has definitely proved that in these patients surviving the operation the membranous valve formed by the operation is ample to protect the kidney.

A recent questionnaire brings the information that not only Lower and myself but many other surgeons have been successful in a similar though smaller way but have not published the results. The reports also reveal many unpublished disastrous results. Looking the good and bad results the outlook has not been roseate. The necessity of two operations each with a high average operative mortality has with rare exception limited the field of the operation to exstrophy of the bladder which could be performed only by those surgeons especially trained and experienced. The two

major problems standing in the way of general use of the operation after the efficiency of the valve had been demonstrated were

1 To preserve uninterrupted kidney function while both ureters were being transplanted at the same operation

2 To minimize infection which had been the cause of nearly all deaths regardless of the type of operation

The closed duct tube technique solved the first problem but infection the chief cause of operative mortality still remained. If the lower segment of the large bowel is segregated it can be irrigated and dry gauze packing be made relatively clean and dry. By retro peritoneal drains protected from contact with intestines by a quarantine or rubber tissue practically all danger from sepsis is dispelled and the operation seems to be as free from danger as the average major abdominal operation. Proof is offered in a report of the first 9 consecutive cases operated upon by the technique herein described: two of the operations were for exstrophy of the bladder, 1 for incurable vesicovaginal fistula, 6 for advanced carcinoma of the bladder. There were no fatalities or near fatalities: there was one ureteral leak due to too much force being used when the catheter was removed, one ascending infection of right kidney due to accidental puncture of the sigmoid with the sigmoidoscope. The patient with the kidney infection finally recovered and became a perfectly healthy boy. In all cases renal function has seemingly been undiminished, the rectal function in the control of urine has been satisfactory and there has been no evidence of kidney disturbance after convalescence.

Since the establishment of this technique I have for the first time felt justified in

recommending this operation for general use in cancer and maladies other than exstrophy of the bladder. I have in past communications expressed the hope that we would at some time perfect a technique which would be safe enough to justify such recommendation. I think we may confidently state that not only the problem but the technique has been solved and that we may now safely recommend the operation to skilled abdominal surgeons, whether urologists, gynecologists or general surgeons in the following cases:

1 Incurable carcinoma of the bladder urethra or prostate for palliative purposes

2 Advanced carcinoma of the bladder urethra or prostate in which it is impossible surgically to remove the growth but in which it is possible with the use of large and even ruthless doses of radium to destroy the growth

3 Early curable carcinoma as an essential part of the operation of total cystectomy which may include prostatectomy in the male or hysterectomy in the female

4 Carcinoma involving the urethra

5 Incurable vesicovaginal fistula

6 Contracted bladder due to scars of ulceration or to other causes

7 Extensive incurable multiple perineal fistulae resulting from various causes

8 Tuberculous ulceration of the bladder in which one kidney remains good, the other to be removed

9 Traumatic injuries which make the use of the bladder impracticable

10 Exstrophy of the bladder

To summarize the indications the operation may be considered justifiable in any condition in which it is necessary to dispense with the bladder as a reservoir for urine.

NOTE.—The No. 12 whistle tip catheters with Spongel stylet can be obtained from C. R. Bard, Inc., New York.

## CRANIAL AND INTRACRANIAL DAMAGE IN THE NEWBORN

## AN END RESULT STUDY OF ONE HUNDRED SEVENTEEN CASES

BY DONALD MUNRO MD FACS BOSTON

CRANIAL and intracranial damage in the newborn commonly referred to as intracranial hemorrhage in the newborn has been subjected to sporadic investigation for many years. This has included postmortem examinations, large numbers of isolated case reports, and various recommendations as to therapeutics. However, a report of a sufficiently large series followed for a long enough time to yield reliable evidence as to the ultimate result of any one method of treatment has never been published. Past studies in etiology and diagnosis have also been largely speculative and lacking in the authority that comes from carefully studied clinical material of sufficient mass.

This paper presents the end results of work carried on for the past 7 years on 117 cases. In addition, considerable data has been collected concerning the etiology, symptomatology, pathology, and treatment. This however must be reserved for future presentation.

except for certain high spots which help to clarify the material under immediate consideration.

## CLASSIFICATION

The cases have been divided into three groups. This was first suggested in a paper published by the writer and R. S. Eustis in the *American Journal of Diseases of Children* in October 1922. Except for certain modifications as to relative importance that plan still proves satisfactory. In addition, the older diagnosis—intracranial hemorrhage in the newborn—has had to be expanded to include certain types of brain and skull injuries not previously covered that may prove fatal or

TABLE II—NUMBER OF PREGNANCY

P	Lvs D d T ul		
	29	5	54
3	8	8	16
4	6	6	2
5	5	4	9
6		2	4
7	2	3	5
8			2
9		4	5
10			
11			1
12			1
13			
14			1
Not g n	1	4	5

TABLE I—CLINICAL AND MISCELLANEOUS DIAGNOSES

Cl	ld g s	L	g	D	d	T	l
Tr m t hem h		34	31	65			
Hemo h g d	hemo h g	3	3	16			
A phx al hem h g				6	16		
C b loed m a t				7	18		
S g alsh k		5	6	31			
F t f k ll		7		7			
Fra t f l l		1	0	1			
B h l p l y		6	1	7			
La t d b		1		1			
M g m		7		9			
Sp l j y				1			
Me g t f t l							
Me g t l A qui d			2	3			
M c l l ou di g							
Hem r h g d	t cr al	6	1	7			
P m t r t y			3	3			
St loon		0	2	2			
H d ph l s			2	4			
Ep l p y d t t u p l p t							
St t thym lymph t c		1					
C g tal yph l		0					
C ng tal h t d		1		2			
C ng tal d l t u o f col		1					
Rck ts				2			
Inf t d w d				1			
Ab of k		0		1			
N d l p r f t o f g t t l us				1			

TABLE III—SYMPTOMATOLOGY ANALYSIS

Imp t t ympt m	L	D	d	T	l
Lo o r y	44	44	83		
Hype t	5	39	9		
Cy	35	4	77		
W uld t	36	36	7		
T f nt l	3	34	64		
Ap th t c		35	57		
Ab m l r p t n	15	3	40		
Sympt m in t 25					
Fl d ty		18	8		
B th phy	8	15	3		
I t al hem h g	7	13			
I t al h ent l ncr yst m		9	31		
Ny tagm	17	9	6		
C l		11	2		
P ll		24	35		
J d	9	3	1		
D y	1	8	9		
C ph hem t m	5	5			

TABLE IV—LUMBAR PUNCTURE DATA

Pressure data	L g	D d	T t
Number of cerebrospinal fluid punctures	56	39	95
Number of punctures made	99	50	149
Number of measurements taken	91	48	39
Highest pressure read	50 mm	48 mm	
Lowest pressure read	—1 mm	—1 mm	
Average pressure reading	10.9 mm	11.1 mm	
Cerebrospinal fluid data			
Bloody fluid—living	37		
deceased	31		
Greatest amount	10 c cm	10 c cm	
Smallest amount	— c cm	3 c cm	
Average amount	4 c cm	3.7 c cm	
Number of amounts measured	0	2	4
Clear fluid—living	12		
deceased	1		
Greatest amount	25 c cm		
Smallest amount	— c cm		
Average amount	10.96 c cm		
Number of amounts measured	7	0	7
Yellow fluid—living	4		
deceased	10		
Greatest amount	17 c cm	4 c cm	
Smallest amount	3 c cm	— c cm	
Average amount	6.9 c cm	3.75 c cm	
Number of amounts measured	18	6	4
Contaminated bloody fluid—living	16		
deceased	4		
Greatest amount	3 c cm	1.5 c cm	
Smallest amount	3 c cm	1.5 c cm	
Average amount	1.11 c cm	1.5 c cm	
Number of amounts measured	7	1	8
No fluid removed in punctures in	10	4	14
Combined cerebrospinal fluid data			
Greatest amount	25 c cm (yellow)	10 c cm (bloody)	
Smallest amount	4 c cm (bloody or clear)	3 c cm (bloody)	
Average amount	5.542 c cm	2.485 c cm	
Percentage	millimetre	millimetre	



Fig. 1. A case of traumatic hæmorrhage and surgical shock. This child a second baby was pale cyanosed and flaccid at birth. Nystagmus was present. One lumbar puncture was made which gave relief of intracranial hypertension. Death from rupture of the lateral sinus occurred 37 hours after birth. Case 47.

including 1 syphilitic case. The fractures and acute cerebral oedema cases when not already so diagnosed have been included among the traumatic groups. Certain entries appear twice in the tables. This is due in part to the fact that the hæmorrhage in the diathesis series is primarily from a rupture of some cerebral vessel caused either by trauma or asphyxia which has failed to close normally because of the peculiar changes in the blood as evidenced by prolonged clotting and bleeding times.

#### DIAGNOSIS

The diagnosis depends in the final analysis on the demonstration of an increased intracranial pressure. This is true no matter what the type of case except when the patient is suffering from surgical shock or as it is called in the older publications pallid

at least disabling. Such cases have no hæmorrhage in or about the central nervous system although they are due to the same etiological factors and present the same indications for treatment as does the hæmorrhagic type.

This grouping of the cases is as follows: traumatic asphyxia and the systemic blood conditions including hæmorrhagic disease of the newborn syphilis etc. In this series as shown in Table I there are 83 traumatic 16 asphyxial and 16 hæmorrhagic disease cases.



F A f t m t h m ha f t b l y  
I b e l t t f 3 h T i l l h y p t  
I m l p t h l m l t l p h l  
D t h 4 s h u i t l l l h l  
I a m h d r j t f t h t h t C 35

TABLE V—CROSS AUTOPSY ANALYSIS OF  
INTRACRANIAL DAMAGE



F g 3 A e f p h y t l h e m r h l r g i l  
l c k a f t b l y I d l l l t h p l p f c o d  
l h d A t b t h c h l l a s p l f l a c d d  
t t t h b t 4 h v r d l u n c c t h  
g u l p t O l m l p u t u h o d h g h  
m a l t m l t T h h l d d l t h f i f t h  
l y f e l r l u l a c h l l a m o l t h n m e n  
g l l m s C 54

asphyxia. Massive meningeal hemorrhage, multiple intracortical hemorrhages, depressed fracture or cerebral edema all produce a definite measurable increase in intracranial pressure. Other symptoms are suggestive but

TABLE VI—CROSS AUTOPSY ANALYSIS OF  
MISCELLANEOUS DAMAGE

TABLE VII—GROSS AUTOPSY ANALYSIS OF  
EXTRACEREBRAL DAMAGE

	Total	T	thy	Hem	C b l
Thyroid	5				
Large		3	0	0	1
Hæmorrhage		1	0	0	0
Mediastinum	1				
Hæmorrhage		1	0	0	0
Pleura	2				
Hæmorrhage		0	1	0	1
Lung	13				
Rupture		1	0	0	0
Collapse			0	0	0
Congestion		5	0	1	3
Pneumonia		0	1	0	0
Intrathoracic hæmorrhage		0	1	0	1
Heart	4				
Hæmorrhage		2	0	0	0
Anomaly		1	0	0	1
Stomach	1				
Acute dilatation		0	1	0	0
Intestine	3				
Hæmorrhage		1	0	0	0
Spasm		0	0	0	0
Anomaly		0	0	1	0
Liver	14				
Hæmorrhage		0	0	0	0
Congestion		6	0	0	3
Large		0	0	0	1
Spleen	6				
Congestion		4	1	0	1
Kidney and ureter	3				
Hæmorrhage		1	0	0	0
Congestion		0	0	0	1
Anomaly		1	0	0	0
Adrenals	8				
Hæmorrhage		4	1	1	1
Omentum	1				
Hæmorrhage		0	0	1	0
Pelvis					
Hæmorrhage		1	0	1	0
Mucous					
Hæmorrhage			0	0	0
Acute	1	1	0	0	0
Hernia	1				
Congenital		1	0	0	0

may be misleading. They may be summed up as follows (Tables II and III) on the basis of having been present 40 or more times either alone or in combination in a first baby which is hypertonic, cyanosed, refuses to nurse from the breast or bottle, has a tense anterior fontanel, is apathetic, and has some respiratory abnormality may be presumed to be suffering from an intracranial injury.

## TREATMENT

Treatment has been based on three fundamental procedures. No active measures were



Fig. 4. A case of traumatic hæmorrhage in a third baby. At birth the child had a cephalohematoma of the entire scalp, hypertonus, a tense fontanel, and labored respiration and was pale. One lumbar puncture gave relief of intracranial hypertension and resulted in an improvement of the symptoms for 5 hours. At 36 hours there was a sudden recurrence and death due to a choroid plexus hæmorrhage and congestion—old and new fracture of the skull and rupture of the vein of Galen and the left internal sinus. Case 55.

knowingly carried out until the patient had recovered from the surgical shock. In the traumatic and asphyxial groups lumbar decompression with a manometer has been performed as soon after the end of the shock period as possible and continued until the cerebrospinal fluid pressure level has again become fixed at normal. In the hæmorrhagic disease group parental whole blood has been given intramuscularly in 30 cubic centimeter doses every 3 hours for 4 doses. This has been repeated at the end of another 12 hours as often as might be necessary to bring the bleeding and clotting times to normal after which lumbar decompression has been started. Depressed fractures were elevated as soon as possible in every case. In addition the babies were left in the hospital under close observation for at least 2 weeks from the day that the cerebrospinal fluid pressure was found to be normal (Table IV). Certain other details which are concerned with the nursing, fluid intake, handling, feeding, and the treatment of a secondary septic meningitic condition which occurs at the end of the second week can not be discussed at the present time.





FIG. 1. Microscopic view of brain tissue showing hemorrhage and edema.

#### FATAL CASES

The end results in the fatal cases have been obtained insofar as possible from both a gross and microscopic study of postmortem material. The microscopic examination of the central nervous system has been carried out in every instance by Dr Stanley Cobb but for whose kindly assistance this work would have been largely impossible. There were 56 primarily fatal cases. Of these 45 came to autopsy. Microscopic studies of the brain were made in 23 cases.

As will be seen from Table V hemorrhage, edema and congestion are the outstanding gross central nervous system pathological entities with hemorrhage appearing 48 times. Twenty-two or almost half of these hemorrhages were subarachnoid in location. Hemorrhage typically appeared in the traumatic class of case (Fig. 1). It was conspicuous by its absence in the asphyxial and cerebral edema classes appearing only once in these. Associated with the hemorrhage we find some degree of laceration of the falx and tentorium in 44 instances (Table VI). The source of the hemorrhage was in the large majority either from the great vein of Galen or from one or both of the lateral sinuses. Twenty-three of the 31 that could be identified occurred in one or the other of these two places. The superior sagittal, the straight and the petrosal sinuses were all about equally involved and were very much in the minority.



FIG. 2. Microscopic view of brain tissue showing hemorrhage and edema.

Meningitis was found 3 times. The most interesting of the cases was one in which the infant lived only 1½ hours after delivery but nevertheless presented an old well organized

TABLE VIII—MICROSCOPIC ANALYSIS OF CEREBRAL DAMAGE

E



Fig 7 A case of traumatic hemorrhage and surgical shock in a full-term baby. The child was flaccid and pale at birth with fracture of the clavicle. On the second day there was hypertonus with convulsions, cyanosis, nystagmus, and a tense fontanel. One lumbar puncture gave relief of the high intracranial tension. The child died at the age of five hours. Postmortem examination showed extensive intracortical congestion, edema, and opening of the cerebellum with rupture of the falx and tentorium and right inferior petrosal sinus. Case 53.



Fig 8 Same case as that shown in Figure 7 showing marked perivascular and perineural edema.

meningitis which must have been present a number of weeks. The gross lesions in the rest of the organs have no particular significance except that the liver, lungs, and adrenals showed the most constant damage (Table VII). Microscopically in the brain we again

TABLE IX—FOLLOW UP OF THE NON FATAL CASES

Age when lost	No. of cases	No. of cases	Letting go	Letting go
Age when lost	No. of cases	No. of cases	Letting go	Letting go
Over 6 years	2			
5/ to 6 yrs	9			
5 to 5 yrs	1			
4/ to 5 yrs	3			
4 to 4/ yrs	1			
3 to 4 yrs	4			
/ to 3 yrs	2	2	Occasional convulsion	
to 2/ yrs			Hydrocephalic idiot	
1/ to yrs			Hydrocephalic epileptic	
1 to 1 yrs	1	4		
6 mo to 1 yr	2	3		
Less than 6 mo				
Total	25	9	3	10

TABLE IX—FOLLOW UP OF CASES FATAL SINCE DISCHARGE

Age at death	Cause of death	Atopy	Etiology	Clinical
Age at death	Cause of death	Atopy	Etiology	Clinical
5 yrs 7 mo	Acute encephalitis following tonsillectomy	Yes	Yes	
1 yr 9 mo	Hydrocephalus and epilepsy	Yes		Yes
1 yr 2 mo	Colectomy for Hirschsprung's disease	No (Operation)	Yes	
11 months	Spastic idiot erysipelas	No		Yes
6 months	Unknown	No	?	?
6 months	Congenital heart disease	No	Yes	
1 month	Unknown	No	?	?
1 month	Hydrocephalus and neglect	No		Yes
2 months	Congenital syphilis	Yes	Yes	
months	Hydrocephalus	Yes		Yes
1 month	Influenza	No	Yes	
Total	11		5	4





Fig. 12

Fig. 12 A case of traumatic hemorrhage surgical shock and meningismus in a first baby. After an excessively difficult delivery the child was pallid and flaccid and not breathing. Twenty-four hours later the child was hypertonic and cyanotic. The fontanel bulged and there were generalized convulsions. One lumbar puncture gave relief from the intracranial hypertension. On the eighth day the fontanel was again tense but there were no other signs. Two lumbar punctures relieved the secondary intracranial hypertension. This photograph was taken when the child was  $3\frac{1}{2}$  years old. She was living and normal at 5 years and 11 months. Case 117.

Fig. 14 A case of acute cerebral edema and surgical shock in a first baby. After delivery the child was pale and flaccid and was not breathing. The pulse count was



Fig. 14



Fig. 15

40. At  $1\frac{1}{2}$  days the child was cyanosed and hypertonic with a temperature of  $106^{\circ}$  degrees. He had a shrill weak cry. One lumbar puncture with the removal of clear colorless cerebrospinal fluid relieved the mild intracranial hypertension. This photograph was taken when the child was  $1\frac{1}{2}$  years old. He was living and normal at 5 years and 11 months. Case 153.

Fig. 15 A case of traumatic hemorrhage in a first baby. On the third day the child was cyanotic and had convulsions with a left external rectus palsy. One ventricular puncture and one lumbar puncture relieved the intracranial hypertension and all other symptoms. This photograph was taken when the child was 4 years of age. She was living and normal when 5 years and 11 months old. Case 147.

having mild generalized convulsions about every 3 months for the past 2 years. These are becoming less severe and have left no demonstrable aftermath. The other was a spastic idiot at 3 months and remained so until he died of erysipelas at 11 months. Of the 5 others 3 lived long enough to show symptoms of either epilepsy or idiocy in addition to the hydrocephalus while 2 living for only 1 and 2 months respectively showed only the underlying hydrocephalus. It is significant that in every case except the 1 that is still living and only having convulsions treatment was inadequate. Either no treatment at all was given after birth or that given was improperly carried out or not persisted in for a sufficient length of time the babies being discharged in spite of the presence of symptoms.

Of the 34 patients still living and normal 24 are over  $\frac{1}{2}$  years of age at this time (Figs 10 and 11). This is significant because in this series cerebral disease when it has oc-

curred has been easily demonstrable within the first 2 years and in every instance but 1 has actually been diagnosed within the first year of life (Figs 12 and 13). The chances therefore favor the normal development of half of the 10 that fall in the groups below  $1\frac{1}{2}$  years. All three types are represented although as shown in Table I the hemorrhagic disease group is in a very small minority (Figs 14 and 15).

The most striking of all of the children (not included among the photographs) is now 6 years and 1 month of age. He goes to school and is normal in every way except for a residual sixth nerve palsy. At birth however this child at one time had an intracranial pressure of 50 millimeters of mercury which was relieved only by removing 90 cubic centimeters of cerebrospinal fluid from his ventricle. Three lumbar punctures and one ventricular puncture were made in a period of 3 weeks and approximately 100 cubic centime-

ters of cerebrospinal fluid were removed. It is obvious that such a degree of acute hydrocephalus and this predication would inevitably lead to a chronic dilatation without some such relief as has been described.

#### CONCLUSIONS

The end results of a series of 117 cases of cranial and intracranial damage in the newborn collected and followed during the past 7 years are presented.

The diagnosis of intracranial hemorrhage of the newborn must be expanded to include cerebral edema and fracture of the skull and should be stated as cranial and intracranial damage in the newborn.

Postmortem gross and microscopic studies conducted on 45 of the 56 primarily fatal cases show that meningeal and intracortical hemorrhage, congestion and edema are the most common pathological entities.

Cerebral intracranial hemorrhage may occur from the rupture of most of the large venous sinuses; the most common sites being the great vein of Galen or the lateral sinus.

Intracortical edema and congestion alone may cause death in the newborn.

Associated developmental anomalies and cerebral developmental defects were in the one case negligible and in the other absent in this series.

Forty-eight of the 58 babies discharged living and relieved have been followed up to December 1927. Thirty-nine of the 48 may be classed as cured; 5 are still too young to allow for a satisfactory estimation of the end result.

The most common late result of cerebral damage in the newborn is hydrocephalus associated with either epilepsy or idiocy. Convulsions alone and spasticity associated with idiocy have also occurred.

Active treatment in this series was limited to lumbar decompression after recovery from surgical shock. In addition parental blood was given intramuscularly in the hemorrhagic disease group. Depressed fractures were elevated as soon as possible. Ventricular puncture was done twice as was a typical subtemporal decompression.

## EXPERIMENTAL AND CLINICAL CONTRIBUTION TO THE QUESTION OF THE INNervation OF THE VESSELS

By RENÉ LERICHE M.D. AND RENÉ FONTAINE M.D. STRASBOURG FRANCE  
F m the S g l Cl c l th U ty l St bo g

WITHOUT doubt surgery of the sympathetic system has contributed greatly to the study of the anatomy and physiology of the innervation of the vessels. Previous to 1913, when the senior writer performed the first periarterial sympathectomy, our knowledge of this particular subject was confined to the studies of Claude Bernard and the English school as represented by Langley and Gaskell. In accordance with the classical doctrine of the physiologists, Leriche explained the hyperemia which he found following his operations upon the periarterial sympathetic as a consequence of the section of the centrifugal vasomotor fibers. But the fact that a unilateral sympathectomy often had a bilateral therapeutic result as first seen by one of us (22) very soon aroused the opinion that this theory was erroneous. Consequently the majority of surgeons who were interested in the surgery of the sympathetic system began to think that the hyperemia following sympathectomies was more active than passive and due rather to section of the centripetal ascending sensory fibers than to section of the centrifugal descending motor fibers.

Since then many surgeons have tried to prove the existence of such sensory vascular fibers and in so doing have employed vastly different procedures. Several have undertaken anatomical research reasoning that if by the section of the sensory fibers contained in the adventitia of the femoral artery one can produce a hyperemia of the foot, one should find in the periarterial sheath long nerve fibers. These they have attempted to dissect but so far no one has succeeded in finding such fibers. In spite of numerous recent studies, one is forced to conclude that our knowledge of the anatomy of the vascular nerves has not been markedly advanced since the well known work of Potts and Kramer and Todd. These writers have shown that with the exception of the iliac and axillary arteries which receive

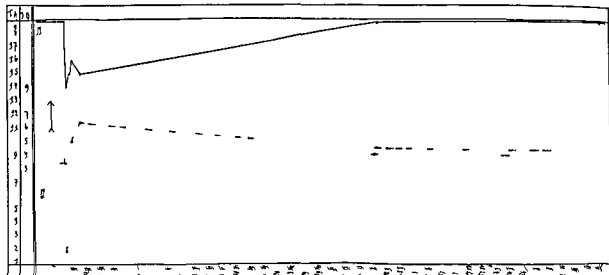
direct fibers from the sympathetic trunk, the innervation of the vessels is segmentary and comes from the adjacent spinal nerves. Such is also the conclusion derived from the more recent work of Odermatt, Wiedhopf, Hahn and Hunclek and Jettmick.

With such segmentary innervation it becomes very difficult to understand the effect of periarterial sympathectomy even though Hirsch, who admits segmentary innervation of the vessels, shows that the nerves reach them in a direction which is parallel to the axis and that after reaching the adventitia the nerve fibers are distributed especially in the neighboring collaterals. Such being the case, a periarterial sympathectomy would denervate the distal segment of the artery and its collaterals rather than the segment upon which the operation has been performed.

Other writers have studied the innervation of the vessels by the use of physiological experiments and have shown that the vessels are sensitive and that by an intra-arterial injection of a 10 per cent solution of barium chloride or a 50 per cent solution of lactic acid one can cause acute pain. Pagano and Friedrich and Hellwig think that the pain is produced in the intima of the arteries themselves but Odermatt and more recently Dumpert and Flick claim that pain is produced only after the injected solution has reached the arterioles and capillaries.

In any event after section of the sensory nerves an intra-arterial injection of lactic acid still produces pain (Friedrich) and such a section does not interfere with the vascular reflexes (Stewart and Lasser) but after a periarterial sympathectomy the injection becomes painless (Hellwig).<sup>1</sup>

We need not dwell longer on these physiological experiments which have been analyzed elsewhere and which were critically reviewed in Odermatt's paper. Here we shall



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limit ourselves to saying that the great majority of surgeons who have experimentally studied the innervation of the vessels believe that sensory fibers for them really exist. Wiedhopf and Lingley alone basing their opinion on contradictory studies on animals deny the existence of such fibers.

The fact that a unilateral periarterial sympathectomy frequently has a therapeutic effect on both sides—that the deep sensation is recovered after the section of all cerebrospinal nerve (A. Thomas and Foerster) and that sympathectomy is successful in many painful syndromes are all proof of the existence of sensory nerves in the vessels. But just as it is true that many physiological and clinical facts cannot be explained by the old vasomotor theory, one must also concede that up to the present no sensory fibers have been anatomically demonstrated. This is why in recent years so many new theories concerning the innervation of the vessels have been advanced. In view of their anatomical research some author still deny the existence of long sympathetic fibers, especially of sensory ones in the arterial adventitia and so they fail to give a satisfactory explanation

of the vascular changes which occur after sympathectomy. Other surgeons who base their opinions upon such clinical and physiological experiments as we have previously mentioned believe that the vessels have sensory fibers but have nevertheless frequently advanced opinions which have been in direct contradiction to the actual anatomical findings.

The theory which we offer does not disagree with the anatomy although we cannot at present give the anatomical proofs of our statements. They are based entirely upon our observations on human beings and so avoid the criticism that what may be true with animals is not necessarily applicable to man.

After sympathectomy whether a part of the trunk is removed or only the preanglionic or postganglionic fibers are cut, vascular changes occur which cannot be explained by the classical theory of vasomotor activity. As we have elsewhere discussed the facts at length (25) we shall only mention them briefly. Besides the clinical findings which we have already mentioned, the most important points are as follows:

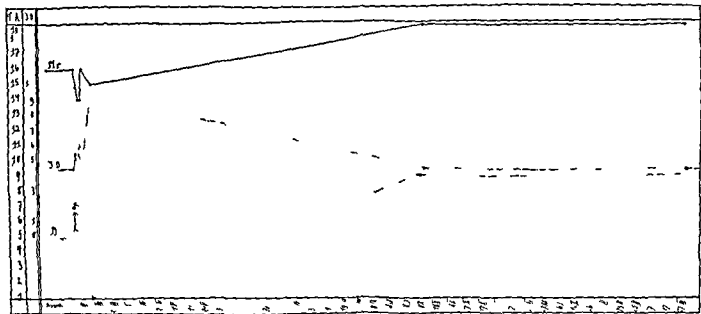


Fig. 2. Right side (intact). Same case as that recorded in Figure 1.

1. In man after all operations upon the cervicothoracic sympathetic trunk whether it is entirely removed or only the ablation of the superior or stellate ganglion is performed or only the rami communicantes are cut one observes at the level of the upper extremities after a short period of increase in the arterial tension a marked lowering of the maximum and minimum pressure while the oscillometric index remains increased. In a few weeks the arterial pressure again reaches its original level and the oscillometric index becomes stabilized at its normal figure. Sometimes the postoperative figures are a little below the preoperative. So one may see that within a few weeks the effect of a sympathectomy upon the blood pressure in the leg affected by the operation disappears entirely.

If one is curious enough to examine the blood pressure in both legs at the same time one will find the same vascular changes in both with a parallel and simultaneous evolution. This is shown by the graphs of two cases. The blood pressure was regularly checked for one year and was measured with Dr. Pichon's instrument. The first patient, Mr. Rue (Figs. 1 and 2), had the superior part of the cervical trunk down to a point above the stellate ganglion removed with a section of the rami communicantes of this ganglion. The second patient, Mrs. M. (Figs. 3 and 4), who was also operated upon for angina pec-

toris had undergone a superior and inferior cervical ramisection on the left side. The vascular changes in both cases were bilateral but transitory. One year after the operation the blood pressure and the oscillometric index were the same as before operation.

3. The same vascular changes occur in the lower extremities after any operation upon the lumbar sympathetic trunk and these also are bilateral.

4. Frequently following cervical or lumbar sympathectomy modifications in the blood pressure are found in all four extremities. As proof of this statement we submit 4 graphs (Figs. 5, 6, 7, 8) which we obtained from a man 30 years of age upon whom we performed a left lumbar ramisection for reflex disturbances in the left lower extremity. After the operation this patient had the typical modifications of the maximum and minimum pressure and the oscillometric index in all four extremities. The pressure in the arteriole measured with Gaertner's tonometer showed the same changes everywhere. Five weeks later all of these variations were found to have returned to the preoperative rate.

5. Territorial sympathectomy frequently produces all of the signs of an active vasodilatation not only on the side operated upon but on both sides and often in all four extremities. Within a few weeks the circulation again becomes normal.



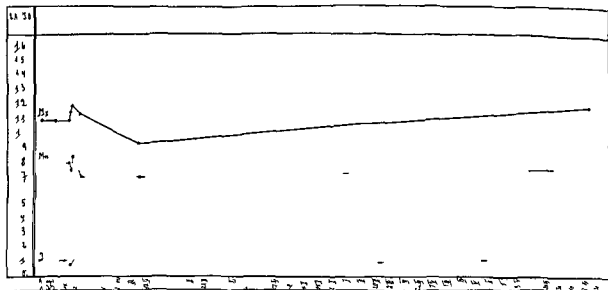


Fig 3 Left d (p t d p) M M S t of arms by th llat ry method a d the llo m tr c  
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6 The resection of an obliterated arterial trunk acting in the same way as a periarterial sympathectomy produce a vasodilatation with active local hyperæmia and hyperleucocytosis. This too returns more or less rapidly to normal.

7 In certain cases namely Buerger's disease in which one finds an obliterated venous trunk the resection of this trunk also produces a temporary hyperæmia.

*All of these facts cannot be explained by the classical theory of asomotor activity but they can be readily understood if one advances the hypothesis of sensory fibers in the vessels.*

On the contrary there are now certain other facts which seem to indicate that sympathectomy does really destroy motor fibers. The most important is the following. We know that Claude Bernard found that in animals the removal of the superior cervical ganglion produced a marked hyperæmia in the corresponding foreleg which persisted over a period of 18 months following operation. In human beings we have observed the same phenomenon after operations upon the cervical and more often upon the lumbar sympathetic. We found in these cases more

than 1 or 2 years after operation a persistent elevation of the local temperature of the involved limb. The increase was 1.2-4 and in one case 7 degrees C and at the time of the last examination when these figures were recorded all other vascular changes due to the sympathectomy had disappeared.

The patient whose graphs are shown in Figures 5 to 8 represents a typical case. Six weeks after a left lumbar ramisection the maximum and minimum pressure the oscilometric index and the pressure in the arterioles had returned to the pre operative rate in all four extremities but the left lower extremity still showed an increase of degrees C in its local temperature. Four months later this hyperemia still persisted.

Adson Brown and Rowntree and Allen at the Mayo Clinic have made similar observations following lumbar ganglionectomy. These apparently indicate a vasomotor paralysis caused by the operation and this would be completely in accord with the classical theory of vasomotor activity.

If one carefully observes the vascular changes following sympathectomies one concludes that some results indicate that while

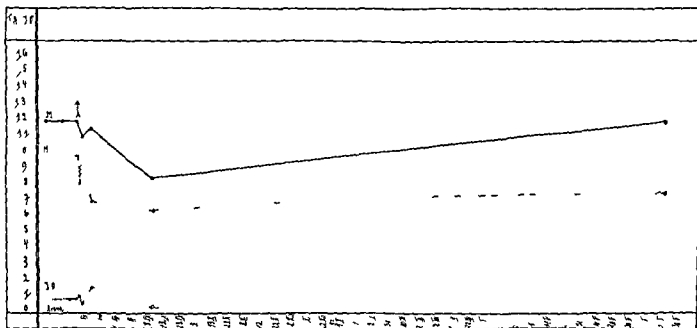


Fig 4 Right side (intact) Same case as that recorded in Figure 3

the operation has only a very transitory influence upon the circulation other modifications are deeper and more persistent. This again brings up the question as to whether or not sympathectomy really produces a vaso-motor paralysis.

We shall answer this by a study of the vascular reflexes. Our observations have been made on patients whom we have seen for recent or old traumatic nerve sections or upon whom we have performed therapeutic neurotomies. The section of the nerves in all of the patients was verified at the time of operation.

The best way to ascertain whether or not the section of the so called vasomotor nerves produces a paralysis is to see if the blood vessels in the denervated area respond to excitations which normally produce either a contraction or dilatation of the arterial wall. Cold should instantaneously produce a marked vasoconstriction and heat a vasodilatation. If by sympathectomy one really interrupts the vasoconstrictors the vessels should not be able to contract. On the other hand if the spinal nerves really contain the vasodilators heat should no longer produce an increase of the blood supply when these nerves are cut. In other words in either case the vessels should no longer be able to adapt themselves to external heat and cold.

We have studied these reactions by inscribing the oscillations obtained with Dr Pachon's instrument upon a kymograph. First we took the normal curve then for 10 minutes the limb was put alternately in water at 40 degrees and 10 degrees C. After each bath a new curve was taken and by comparing the results we were able to judge the reactions to external heat and cold. The following cases were examined:

*I Six patients had at some time undergone sympathectomy*

CASE 1 Mrs L. had had the left stellate ganglion removed for bronchial asthma 1 1/2 years before.

CASE 2 Mr B. had had the left stellate ganglion removed for bronchial asthma 18 days before (Figs 9 to 14).

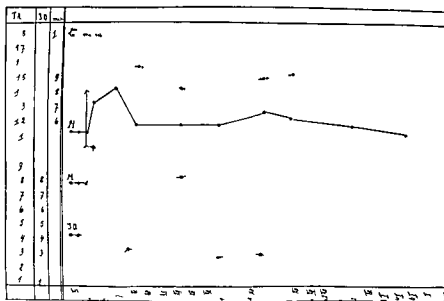
CASE 3 Mrs S. had been operated upon 6 months before. She had had an inferior cervical ramisection performed for reflex disturbances in the upper extremity (Fig 15).

CASE 4 Mrs T. had had a bilateral inferior cervical ramisection and a bilateral perihumeral sympathectomy for scleroderma performed 1 1/2 years before.

CASE 5 Mr K. had had a left lumbar ramisection done for reflex disturbances in the left lower extremity.

CASE 6 Mr F. had had an inferior cervical ramisection for Raynaud's disease a few days before.

*II Five patients had suffered traumatic sections of the spinal nerves.* In several cases the trauma was old in the others more recent. These sections were verified by operation and two of these patients have also had sympathectomies performed.



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 O t l pp t mt tl W d W d te m l by tl llat y m th d  
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 d W f th ip t mt l h th t d y fl th pe t l t  
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 the t t t t th m l l tl th t f th th d  
 W d t m m m l l p W d t m m m blood p e  
 IO d t ll m t d ++ d t t met c d

CASE 1. S. month ago M. N. had a gunshot wound of the head and the mandible. Complete cure.

CASE 2. M. F. had a complete section of the radial nerve of the right arm 4 months before.

CASE 3. M. L. as a soldier during the war (1918) had a complete section of the sciatic nerve of the right thigh. Six years later for a complete paralysis of the muscles of the right hand and foot but complete recovery of the hand. This injury was received in an automobile accident 3 months before examination.

CASE 4. M. Z. had had a complete section of the sciatic nerve of the right leg 9 months before and a lumbar resection 3 months before examination.

CASE 5. M. F. had had a partial section of the brachial plexus (the fifth and sixth cervical roots) of the right arm and shoulder but complete recovery of the hand. This injury was received in an automobile accident 3 months before examination.

CASE 6. M. F. had had a complete traumatic section of the spinal cord at the level of the eighth dorsal vertebra. This has been verified by laminectomy. The accident dated back 4 months. Two

months later a peripheral sympathectomy had been performed on the right side.

CASE 7. Mr. H. had a spasmodic quadriplegia after the fracture of several cervical vertebrae 5 months before. Laminectomy had been performed.

CASE 8. Mr. S. had had a spinal cord syndrome of unknown origin accompanied by marked vaso-motor changes and a spontaneous right-sided Claude Bernard Horner syndrome which could not be explained by the compression of the cervical sympathetic and seemed to be of medullary origin.

In all of these 14 patients the reactions to heat and cold were normal. The cold bath always produced a marked reduction in the amplitude of the oscillations which in hot water rapidly became normal and then increased in size. There may have been some difference in the intensity of the reactions depending upon the individual patient but we found the same variations in a series of normal persons whom we examined in order to establish a control. This may be explained by the fact that all of our patients were not of the same age and as is well known older persons

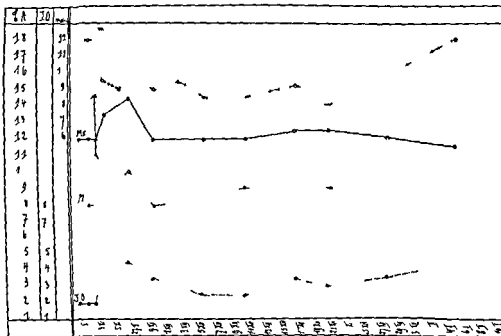


Fig 6 Fight up per extremity Same case as that recorded in Figure 5

have less extensible vessels than younger ones. We also know that the intensity of all nervous reactions varies greatly depending entirely upon the individual.

In any event there is no doubt that all of these patients who following the classical theory could be considered as suffering from vasomotor paralysis reacted normally to the hot and cold water baths.

From these observations one would conclude that the complete section of the lower dorsal spinal cord, the compression of this organ, the complete removal of the cervico-thoracic sympathetic, the section of the lumbar rami communicantes, the section of important nerve trunks for example the median radial or sciatic nerves or the roots of the brachial plexus will not prevent the vessels from reacting normally to adequate excitations. They still contract under the influence of peripheral cold and dilate on the application of external heat.

We should like to emphasize this point by utilizing the example furnished by the patient who had a complete section of the sciatic nerve which had produced trophic complications. He was successfully submitted to a perineural sympathectomy and later to a lumbar ramisection. The last lumbar ganglion was also removed. One would conclude that this patient would have as nearly as possible a

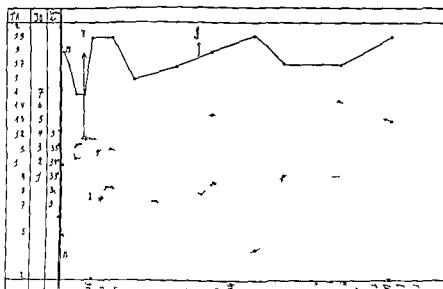
complete interruption of the vasomotor fibers. Nevertheless his reactions to heat and cold remained normal on the side affected by the operation.

In summary we may say that

1 After section of the so called vasomotor nerves the blood vessels are not paralyzed. They are still able to contract and dilate upon the external application of heat and cold.

2 The reflexes which affect the circulatory changes associated with the external temperature must be considered independent of the spinal cord and of the centers of the sympathetic trunk. The fact that these reactions remain normal even though the section of the spinal nerves dates back far enough for degeneration of the peripheral ends to occur proves that there can be no question of any avone reflex.

For this reason we are once more obliged to stress the great importance of the vasomotor to the peripheral intramural centers which we believe are contained in the arterial wall itself. It seems to us that the vascular changes following the external application of heat and cold illustrate the simplest type of vascular reflex and require only the integrity of the intramural centers. It is however a true reflex because it needs a sensory element capable of appreciating the variations of the temperature and a motor element which



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 d J l e) — M d t m v m m bl d p e s u M d t  
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controls the contraction or dilatation of the vessels

We do not believe that all vascular reflexes have such a short path. This can be demonstrated by the study of vascular changes following the application of mustard oil as done by Bruce, Breslau, and Fischer. In experiments upon a cat, Breslau and Bruce have observed that in inflammatory redness can be produced with mustard oil even after complete section of the spinal cord if the section is not of too long standing. We have found the same to be true in humans; for instance, a patient who had a spinal cord section at the level of the eighth dorsal segment gave a positive reaction in the anesthetized region of the lower limbs 10 months after the section, but the reaction was less marked than on the intact upper extremities.

Bruce and Breslau also observed that following section of a nerve trunk the mustard oil test remained positive as long as the peripheral nerve endings had not entirely

degenerated. The reaction does not occur in the anesthetized region years after the section.

Truncular anesthesia does not prevent the reaction, but the local infiltration of novocain abolishes it entirely (Breslau).

Our patient who had had a section of the sciatic nerve in 1916 had a negative mustard oil test, but on the other hand our patients who had undergone sympathectomies all showed normal reactions. So we agree with Bruce and Breslau that the mustard oil test is based upon an axone reflex and as such requires at least partial integrity of the peripheral part of a sensory nerve.

This shows that all vascular reflexes do not travel the same path. The way may be simple or it may be more complicated. The reaction to heat and cold is an example of the very short reflex while the vasomotor change produced by mustard oil enters into the group of axone reflexes. We can therefore divide the vascular reflexes into the following groups:

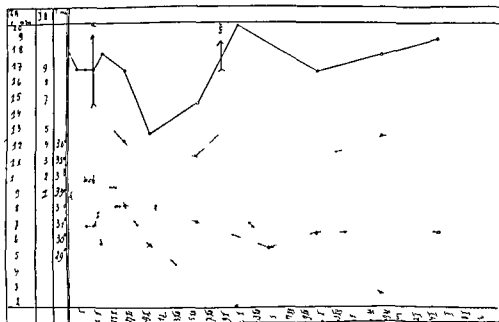


Fig. 8. P, ht leg. Same case as that recorded in Figure 5.

1. Peripheral vascular reflexes having their center in the intramural plexuses
2. Vascular changes through axone reflexes
3. Intrasympathetic reflexes which have their center in the ganglia of the sympathetic trunk
4. Medullary vascular reflexes
5. Cerebral vascular reflexes

If there are long vascular reflexes it seems to us that no doubt remains that the motor innervation of the vessels comes from intramural centers which correspond to the similar centers in the gut and the heart.

Besides these peripheral centers there is a rich extrinsic nervous system consisting of association fibers only which makes it possible for the vascular changes in one part to be in harmony with the blood supply of the whole body. This extrinsic nervous system which is composed of excitator and inhibitory fibers plays a most important role but it should never be thought to consist of centrifugal fibers partly vasoconstrictor and partly vasodilator. To demonstrate its action we cite the following observations.

In patients with an old section of the sciatic nerve we often observed that the leg suddenly became very much reddened and very warm then later for apparently no reason it became very cold. We found that the local temperature was lower than that of the other

limb. During both periods normal vascular changes could be obtained with hot and cold water. We now believe that these very rapid and spontaneous changes from extreme vasodilatation to extreme vasoconstriction which occurred for no apparent reason when the patient was in bed indicate that after the section of the sciatic nerve which contains the association fibers for the lower limb the vessels lose the ability to regulate their own circulation in harmony with that of the rest of the body.

Such being the case we must admit that every vasomotor reaction regularly produces two kinds of vascular changes: (1) changes in the local circulation of the region affected by the operation through short reflexes and (2) changes in the general circulation through long reflexes.

A very simple experiment demonstrates this point. If one dips one's hand in hot water the skin becomes red in a few minutes. The color of the skin on the other side does not change but on examination with the oscilloscope we find increased oscillations on both sides. So if one considers only the effect upon the blood pressure one would say that the vascular changes are bilateral. However if one notices only the change in color one would say that the effect was strictly unilateral and limited to the area where heat was applied.



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 t h p t d l f t t h t t g l t l



Fig Left d ft ld bath



I Left d ft hot l t l

Actually the immersion in hot and cold water produce two kinds of vascular changes: that is, local variation through short reflexes and general changes by long distance reflexes only the last having a bilateral effect. By measuring the blood pressure we obtain the effect of the long reflexes only; the modifications in the local circulation are more difficult to a certain and we generally see their effect only in the form of increased local heat.

Under certain conditions, especially where the excitation are slight the influence upon the general circulation may be so small as to be nearly absent but generally speaking the effect of peripheral excitation upon the circulation can be found. Lately in collaboration with Dr Milojewitch we have observed this in peripheral trauma of the limbs which instantly produce changes in the local and general circulation.

Therefore if one always considers in all vasomotor reactions the double effect upon the local and the general circulation it becomes easy to understand the apparent disorder which exists after sympathectomy where one finds on one side a transitory but generalized effect upon the maximum and minimum pressure the oscillometric index

and the arteriolar pressure and on the other side a strictly localized hyperemia which is very persistent.

The modifications in the general pressure are the result of long distance reflexes produced by the operative trauma; the hyperemia is the consequence of the suppression of a certain number of association fibers with pressor effect. This suppression gives the arteriole capillary system a certain degree of autonomy, lowers the arteriole capillary tone and produces a peripheral vasodilatation. However the vessels are not paralyzed and the vasomotor phenomena produced are active and not passive.

In other words every sympathectomy produces (1) changes in the general circulation through long reflexes which are produced by the operative trauma of the nerves of the vessel; (2) modifications in the local circulation of the limb operated upon which are the consequence of the suppression of the association fibers with pressor effect.

Therefore the changes which occur after sympathectomy should be explained as follows:

1. After a periarterial sympathectomy the contraction of the arterial segment operated upon is the result of a direct trauma of the



Fig 12 Right side (intact) Normal curve



Fig 13 Right side after cold bath



Fig 14 Right side after hot bath

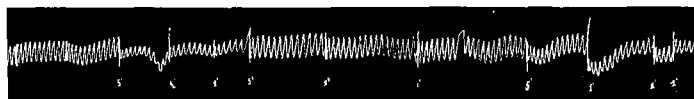


Fig 15 Mr. S. Section of the communicating ramus of the left stellate ganglion had been performed 1 1/2 years before. The curve was determined under a constant

pressure of 9 centimeters of mercury. The left forearm was alternately submerged in cold and hot water. The reactions were also normal in this case.

intramural peripheral centers. This contraction lasts only a few hours. The vasodilatation which follows is produced by long reflexes. For this reason it may be bilateral and even produce modifications in the maximum and minimum pressure and the oscillatory index in all four extremities.

The periarterial sympathectomy changes the circulation in the extremity operated upon and this simultaneously produces an increase in the local heat.

These local changes are less marked after periarterial sympathectomy than after sympathectomy upon the trunk, the reason being that a periarterial sympathectomy does not interrupt so many pressor fibers. The hypotension is therefore less marked and less persistent than after operations upon the sympathetic trunk.

3. After operations upon the sympathetic trunk the same vascular changes occur as those after periarterial sympathectomy, but since the arterial wall is not directly injured the initial contraction does not occur.

# CONCLUSIONS

1. The motor innervation of the vessels is due to peripheral nerve plexuses in the arterial wall itself.

2. The extrinsic nerves of the vessels play the role of association fibers with pressor or depressor effect.

3. The simplest vascular reflex has the peripheral plexuses as a center and the reaction to heat and cold is a reflex of this kind.

4. There are more complicated vascular reflexes: (a) the axone reflex (as demonstrated by the mustard oil test); (b) intrasympathetic; (c) spinal cord and (d) cerebral vasomotor reflexes.

5. Every vasomotor reaction should be considered from two standpoints, namely, its influence upon (a) the general circulation and (b) the local circulation of the limb operated upon.

6. In the particular case of sympathectomy this double effect must be taken into consideration. The modifications in the blood pressure are common to all four extremities.





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Fig L f t d e f t e r c l d b t h



Fig L f t l f t h t t h

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Fig 12 Right side (intact) Normal curve



Fig 13 Rht side after cold bath



Fig 14 Right side after hot bath

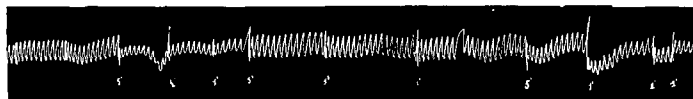


Fig 15 Mrs S Section of the communicating ram of the left stellate ganglion had been performed 1 1/2 years before The curve was determined under a constant

pressure of 9 centimeters of mercury The left forearm was alternately submerged in cold and hot water The reactions were all normal in this case

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6 In the particular case of sympathectomy this double effect must be taken into consideration The modifications in the blood pressure are common to all four extremities

and therefore symmetrical. They are transitory and due to long distance reflexes produced by the operative trauma of the vascular nerve. The local changes are more persistent but strictly confined to the side operated upon. They may be explained by the suppression of certain fibers with pressor effect.

The vascular changes are the same after both periaxillary sympathectomy and operation upon the sympathetic trunk but in the latter case the modifications in the local circulation are more marked as more pressor fibers have been cut. There is a quantitative but not a qualitative difference between these two operations.

Our theory of the vasomotor activity is not contradicted by anatomical factors. In view of the segmentary innervation of the vascular true one can understand that a periaxillary sympathectomy although it may be made at a level far distant from the lesion may through long reflexes produce general changes in the circulation and lower the arteriole capillary tension by the uppression of some pressor fibers thus producing an increased local heat. The fact that the hyperemia after periaxillary sympathectomy is less persistent than after sympathectomy upon the trunk only demonstrates that with the latter more pressor fibers are cut.

Such are our observations and conclusion on sympathectomies performed upon human. Our theory has not yet the anatomical confirmation that intramural centers do exist in the arterial wall for to date they have been found in only a few vessels. We hope that we will one day be able to prove their existence.

#### LIBRARY

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- 8 MAGNUS Experiments in innervation of vessels Arch f klin Chir 1926 cxliii 574
- 9 ODERMATT Die Schmerzempfindung d Blutgefäße u die Cefassreflexe Beitr z klin Chir 19 2 cx i 1684
- 30 IACINO Arch ital de biol 1900 xxviii 1
- 31 PORTS The distribution of nerves to the arteries of the leg Anat Anz 1925 xlvii 138
- 32 SCHILL and STRAUß Physiolog Unters ueber die periph Bahnen d Cefassnerv klin Wchnschr 19 5 iv 1390
- 33 STRAUß O Beobachtungen an Cefassen nach Operationen am Sympathicus Archiv f d ges Physiolog 19 4 cxiii 57-60
- 34 STEWART and LAFFER Arch internat Med 19 3 ii 365
- 35 THOMAS A Compt rend Soc d biol 1917 lxxx 872
- 36 VON TSCHEKMACKE Die Lehre von der tonischen Innervation Wien klin Wchnschr 1914 cxviii 309-314
- 37 WIEHLHOFF Experim Unter uch ueber die Wirkung d P S A u die Nerven eisin an den Gefäßen der Extremitäten Beitr z klin Chir 19 4 cxv 399-445
- 38 Idem Der Verlauf der Gefäßeinnervation in den Extremitäten u deren Wirkung b der Peristalt Symp Muen len m d Wchn chr 19 5 lxxii 413-417

LEIOMYOMATA OF THE INTESTINES<sup>1</sup>

By JOHN A. WOLFER, M.D., F.A.C.S., CHICAGO  
Associate Professor of Surgery in the University of Medicine and Surgery

**S**MOOTH muscle tumors of the intestines occur frequently enough to be considered in the differential diagnosis of intra abdominal tumors and in establishing a possible causative factor for certain intestinal complaints including intestinal obstruction. The frequency of a mistaken diagnosis warrants reporting a case in detail and calling attention to the clinical and pathological aspect of this type of neoplasm.

## CASE REPORT

Mr I. S. Polish, 44 years old, was admitted to Wesley Memorial Hospital on June 6, 1917. His wife and 5 children were living and well. His only complaint was of a large, painful mass in the upper right abdomen which he had first noticed about 6 months previously. It had first been felt in this region about 10 months previously. At that time it was neither severe nor constant but it gradually grew worse and became practically constant. There was no food relation to the pain and the patient had been able to eat anything. His appetite had remained good until shortly before coming to the clinic. There was no nausea or vomiting. He had no dyspnea, no cough or chest pains and no frequency of urination and there was no association of the pain with urination. He had had occasional headaches but no vertigo. He slept well. During the past months before entering the clinic he had had 3 or 4 watery stools daily. He had lost 35 pounds in weight during the past 10 months. His past and family history gave no additional information and he denied any venereal infection.

An examination revealed a rather poorly nourished male with pale skin and thin gray hair. There was no discharge from the ears. The pupils reacted to light and accommodation. The tongue was furred

and the teeth were in poor condition. The supraclavicular fossae were sunken and the chest was thin but the lungs were essentially normal as to physical findings. The heart was normal. The skin of the abdominal wall was atrophic and the muscles were relaxed. An ovoid mass could be palpated in the right side. It extended from the costal margin down to the crest of the ilium and from the median line well to the right flank. It was smooth, firm, freely movable and not especially tender. When the patient lay on his left side the tumor would shift well to the left side of the abdomen. It descended with inspiration and seemed to swing from the gall bladder site. The lower edge of the liver could be palpated on deep inspiration and lay anterior to the tumor. The spleen was not palpable but it was thought that the right kidney could be felt behind the mass. The prostate felt normal in size. All reflexes were normal. In the left buttock was found a soft, well defined mass about the size of a lemon. This was freely movable and thought to be a lipoma.

The stools were semi-solid, brown and well digested. The benzidine test for blood was strongly positive and there was present an occasional pus cell but no mucus. The blood Wassermann was negative. The urine had a specific gravity of 1.030, was amber in color and turbid with a faint trace of albumin and no casts. There were 75 white cells per field. At other times double plus albumin with hyaline and granular casts was found. The blood count showed hemoglobin 70 per cent, red blood cells 4,760,000, leucocytes 11,300, polymorphonuclears 86 per cent, lymphocytes 12 per cent, large mononuclears per cent. A cystoscopic examination showed a normal bladder mucosa with slight enlargement of the median lobe of the prostate. The ureteral orifices were normal and clear urine could be seen spouting from each. The ureteral catheters passed easily, phthalein appearing from the left



Fig 1



Fig 2

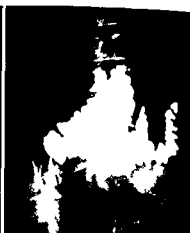


Fig 3

Fig 1. The gall bladder is shown in situ, with the tumor mass visible on the surface. The tumor is a dark, irregular mass, approximately 4 cm in diameter, located on the right side of the gall bladder.

Fig 2. The gall bladder is shown in situ, with the tumor mass visible on the surface. The tumor is a dark, irregular mass, approximately 4 cm in diameter, located on the right side of the gall bladder.

Fig 3. The gall bladder is shown in situ, with the tumor mass visible on the surface. The tumor is a dark, irregular mass, approximately 4 cm in diameter, located on the right side of the gall bladder.

Fig 3. The gall bladder is shown in situ, with the tumor mass visible on the surface. The tumor is a dark, irregular mass, approximately 4 cm in diameter, located on the right side of the gall bladder.

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Fig 4. The gall bladder is shown in situ, with the tumor mass visible on the surface. The tumor is a dark, irregular mass, approximately 4 cm in diameter, located on the right side of the gall bladder.

Fig 5. The gall bladder is shown in situ, with the tumor mass visible on the surface. The tumor is a dark, irregular mass, approximately 4 cm in diameter, located on the right side of the gall bladder.



Fig. 11. Low power photomicrograph showing typical smooth muscle cells.

bladder was made although we questioned the possibility of a gall bladder shadow if the viscous overlaid the tumor due to the opacity of the tumor.

**Operation.** On July 7 the abdomen was opened through a right paramedian incision. When the peritoneal cavity was opened a large tumor mass came into view. This mass lay behind the ascending colon and pushed the hepatic flexure to the left and downward. The lower edge of the right lobe of the liver projected over the upper part of the tumor. The gall bladder was free and moderately filled with bile and lay over the tumor. The tumor mass felt



Fig. 13. High power photomicrograph showing the typical cigar-shaped nuclei of smooth muscle cells.

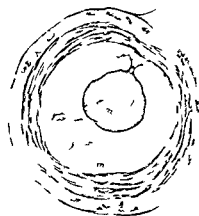
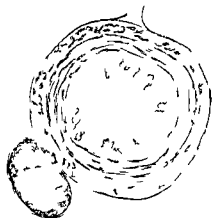
smooth except for a knob which could be seen projecting from the median lower surface of the tumor to the left of the ascending colon. The parietal peritoneum which was reflected from the external surface of the ascending colon was split and the mass rather easily enucleated from behind the colon. An area of the anterior surface of the tumor about 8 centimeters long and 2 centimeters wide was closely adherent to the posterior surface of the colon. It



Fig. 18. A moderate to high power photomicrograph showing all of the cells with practically no wall. The surrounding area is cellular and appears to be smooth muscle.

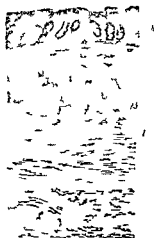


Fig. 19. A low power photomicrograph of a section cut through the area of attachment of the tumor to the gut wall. Although the tumor mass is at the lower part of the photograph, it does not appear to be growing directly from the gut musculature; it is encircled by closely associated with it.



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## THU 3UMOB

The tumor weighed approximately 1050 grams. It measured 13 centimeters in its widest diameter and was ovoid in contour. One knob about 3 centimeters in diameter and 2 centimeters in height projected from what had been the anterior inferior surface (Fig. 4). The surface of the tumor was smooth with here and there tags of connective tissue. Many sized veins lay in the capsule. The color varied from grayish white to pink white with areas of brownish discoloration. The mass was of a firm consistency and offered considerable resistance to cutting. The cut surface varied in color from gray to pinkish white. Areas measuring as much as 3 centimeters in diameter were brown in color and represented old hemorrhage with degeneration (Fig. 5).

Many whorls of neoplastic growth as in uterine myomata could be seen. Lying between the main tumor mass and the resected gut were two small nodes one about 3 by centimeters and another somewhat smaller. The cut section of these nodes was very pale. The entire mass was intimately attached to the gut wall over an area about 5 centimeters in length and 2 centimeters in breadth.

Sections from the tumor showed typical smooth muscle cells with characteristic cigar shaped nuclei (Figs 6-7). The same type of cells was found in the several small nodes already described. In selected areas the body of the muscle cells seemed atrophic but as a rule the nuclei retained their morphological characteristics. In some areas thin walled blood vessels were few while in other regions they were quite numerous (Fig. 8). Sections through the areas of discoloration indicated degeneration of the muscle fibers. There was present in the white firm areas a large amount of connective tissues with hyalinization. Edema was present in various parts of the tumor. A large section cut through the area of attachment of the tumor to the gut wall failed to indicate definitely that the tumor took its origin from the musculature of the gut wall although there was a close association between them (Fig. 9).

This was therefore a leiomyoma growing from the ascending colon.

Throughout the literature occasional references are found to myomata of the gastrointestinal tract. In 1898 Steiner gave a detailed description of this tumor and reported from the literature 58 cases of myoma of the gastrointestinal tract, 23 growing from the stomach and 35 from the gut including 3 new cases. The earliest reference was made by Boerhaave in 1728 who mentioned *Polyposis Gewaeches der Fleischichte des Darmes*. Probably the first authentic description was by Foerster in 1858 who described the Fibroid of the Muscularis of the Ileum.

#### PATHOGENESIS

Needless to say no definite etiological factor can be vouched for. Steiner mentioned the frequency of small circumscribed myomata or

polyps near areas of diffuse hypertrophy of the stomach and gut musculature the tumors being the result of irritation. This followed the theory of Virchow. Winkle went one step further and stated that he believed the tumor to be the result of disturbance in circulation due to trauma or inflammation with possible changes in the vessel walls due to syphilis or chemical changes in the blood such as caused by parasites. Gottschalk found among the muscle cells in very small myomata chromatin rich nuclei. He believed these to be nuclei of muscle cells or nuclei of cells of the lymph vessels or mast cells and attributed great importance to them. Since they are not found in larger tumors he believed that they must play a decisive role in the etiology of the tumor.

The immediate site of origin of the tumor must be in a muscle structure of the gut wall either of the muscle coats or the muscularis mucosa (Foerster, Virchow, Boettcher, Brodowski, Wesener). Klebs and Roesger believed that the tumor grew from the muscle of the vessel walls. Lubarsch also concurred in this as he had seen small myomata intimately associated with blood vessels.

According to Virchow the tumor begins its growth in a muscle stratum just as a neuroma grows in a nerve. As it increases in size it pushes adjacent tissues aside and extends either inward into the lumen of the gut or outward into the peritoneal cavity or extra peritoneal space. When the growth finds its origin in the longitudinal muscle it becomes an external growth but when it grows from the circular layer it becomes an internal growth.

If one may reason logically it would appear that a small tumor which had its origin in the longitudinal muscle as a result of the resistance of the constantly contracting circular muscle would progress externally (Figs. 10-11) but that when its seat of origin is in the circular layer its growth most likely would be toward the lumen and would be sessile in type. When the origin is in the muscularis mucosa as a result of the constant traction of intestinal peristalsis a typical pedunculated internal tumor would develop (Fig. 12).

The malignant changes in myomata especially in those cases in which metastasis occurs have constituted a topic of contro-



versy Zeit believes that true malignant changes may take place but that benign metastases do occur in the form of emboli of tumor cells which may be carried to the liver. Here they are ordinarily destroyed but the cell may remain viable or may even grow and produce secondary but benign growths. Ghon and Hintz reported a case in which the primary tumor was in the ileum and caused intussusception. There were secondary nodules in the abdominal wall, lungs, chest wall, pancreas, both suprarenals, in the capsule of both kidneys, mucosa of the stomach, so in the small intestine and a thrombus of tumor cells in the seventh intercostal vein. The colon, prostate and large lymph gland groups were free. A number of other cases have been reported. There seems to be no question but that smooth muscle cells may take on an atypical growth, the resultant tumor being sarcomatous in nature and that metastases can and do take place (Langenhans, Hanseman, Minkowski).

Since leiomyomata and their classical prototype in uterine myomata, the latter having been studied in large groups, little can be added to the pathological picture of the tumor itself. Nevertheless, in intestinal myomata the clinical picture lends itself to a classification which is of both pathological and clinical importance, viz. the external type which appears as an abdominal tumor and gives symptoms of being an abdominal tumor, the internal type which produces a variety of irritative intestinal symptoms often culminating in obstruction, and the rectal type which, due to its location and characteristics, is usually mistaken for a carcinoma.

#### EXTERNAL MYOMA

It is assumed that the external myoma finds its origin in the longitudinal layer of the gut musculature. The growth is outward and the leaves of the mesentery are spread or the visceral peritoneum is pushed away. The growth is at the expense of the extra intestinal tissue. The tumors are rarely, if ever, pedunculated and have a fair sized base through which most of their blood supply is derived. According to the age and rapidity of growth of the tumor, the size may vary

from that of a cherry to that of a mass filling the entire abdomen. In Woelfler's case the tumor weighed 7 kilograms. It seems that the larger the attachment of the tumor to the gut wall, the more likely is rapid and progressive growth. Adhesions are not uncommon but never to the extent that the tumor becomes fixed. As a rule the mass is freely movable until it reaches the size where, due to bony or solid visceral proximity, mobility is prevented. The mixed variety may encroach upon the lumen of the bowel and produce partial or complete obstruction. Adjacent organs are often compromised and pressure atrophy of the liver and pancreas may result.

The outstanding sign is the presence of a tumor which has rather free mobility, is frequently nodular and not especially tender. The growth is comparatively slow, at times extending over a period of many years. For example, Kukula reported a case in a male 71 years of age in whom the growth had been felt for 20 years, first as a nodule the size of a hazel nut, later the size of a fist and finally as large as a child's head. When the growth takes place in the wall of the small gut, disturbances in intestinal flow are more common than when the tumor is situated in the colon. This is due to the formation of traction diverticula and adhesions with angulation or pressure. When partial obstruction occurs, cramps, vomiting and obstipation are common and intermittent is a rule. Paresis is the obstruction complete. Strangulation or incarceration of the tumor is possible as in Kukula's case in which part of the tumor was incarcerated in a hernial sac. Sooner or later, due to changes in the mucosa, inflammatory or ulcerative in nature, bloody or mucous diarrhoea may alternate with constipation. In my case in spite of a large tumor, there were no obstructive symptoms at any time but for several months before the patient reported at the clinic, he had had from 3 to 4 watery stools each day and an examination of the feces in the clinic revealed the presence of blood and pus cells. Steiner reported a case of fatal hemorrhage.

The outstanding diagnostic points can be briefly summarized as follows: an intraabdominal slowly growing, often nodular, freely

movable not especially tender tumor which is not connected with the genital tract the manipulation of which produces a drawing pain and which eventually causes disturbances in the passage of intestinal contents and hæmorrhage To this can be added the evidence obtained by means of the X ray with contrast media in the gastro intestinal urinary and biliary tracts

#### INTERNAL MYOMA

An internal myoma most likely grows from the muscularis mucosa but rarely attains the size of the external variety because of the early encroachment upon the lumen of the gut and resultant intestinal obstruction It is most frequently pedunculated and the pedicle often attains a considerable length The mucosa over the tumor may remain intact especially when the tumor is still small Eventually erosions and ulcerations result Inflammation of the surrounding mucosa follows and accounts for the symptoms frequently observed In cases of deep ulceration rather brisk hæmorrhages may occur The pedicle may atrophy and eventually cut through thus isolating the tumor in the intestinal lumen The tumor may then be spontaneously passed *per rectum* In Pelizari's case a girl presented a fair sized tumor in the ileocaecal region which was thought to be an ovarian cyst She began having severe abdominal cramps vomiting obstipation and fever Finally symptoms of ileus appeared Suddenly the patient passed the tumor which weighed 500 grams *per rectum* Prompt recovery ensued

It is possible for a small tumor to be present for a long period of time without producing any symptoms but with increase in size or ulceration symptoms make their appearance Diarrhoea alternating with constipation mucus in the stools bleeding of all degrees from occult blood to exsanguinating hæmorrhage may occur With partial obstruction there follow cramps vomiting obstipation with varying degrees of distention Often these symptoms very suddenly disappear and coincident with the relief the patient passes large quantities of foul bloody mucous stools Not a few of these patients sooner or later develop

an intussusception with its classical picture but varied by frequent sudden and spontaneous relief and then recurrence In the presence of a fair sized tumor or an intussusception a mass may be felt in the abdomen This mass has a tendency to vary in size the decrease being synchronous with symptomatic relief Obstructive symptoms may occur over a long period of time as in Heurteaux's case in which the patient suffered attacks for over 10 years and then the lime covered tumor appeared in the rectum

Steiner tabulated the symptoms as follows (1) the frequent sudden appearance of a tumor in the lower abdomen (2) a tumor in the abdomen which grows slowly for months or years (3) the sudden increase or decrease in the size of the tumor signifying regression or progression of the invagination (4) with the increase in the size of the tumor the appearance of intestinal stasis (5) coincident with the decrease in size of the tumor disappearance of the symptoms with the passage of foul fæces (6) complete relief of symptoms after a severe attack of intestinal obstruction the freedom lasting weeks months or even years

These diagnostic points are as reliable and complete today as they were 30 years ago and little can be added except perhaps the evidence obtained by the newer laboratory methods such as gastro intestinal X ray with contrast media pelvography or cholecystography

#### RECTAL MYOMA

Rectal myomata may be either internal or external The internal type is usually in the form of rectal polyps While the polyp is small it may cause few if any symptoms but as it increases in size constipation may alternate with blood stained loose stools With ulceration mucus blood and pus may be present in the fæces The patient often complains of the sense of a foreign body in the rectum and straining at stool may extrude the pedunculated mass through the sphincter As the tumor increases in size more obstructive symptoms appear leading to subtotal or complete obstruction Coincident with the varying degrees of obstruction colic nausea and vomiting occur Digital or instrumental

examination will reveal the presence and character of the tumor

The external type presents a perplexing and confusing picture. These tumors usually grow from the posterior wall of the rectum and after a time fill the hollow of the sacrum. The progress of growth in this direction is then arrested but the growth then proceeds upward and laterally and pushes the rectum anteriorly toward the bladder. The mucosa is stretched over the mass offering resistance to the onflow of fecal contents. Ulceration and necrosis may then take place and result in mucous and bloody stools. Constipation alternates with foul bloody diarrhea. These tumors may attain an enormous size. Senn reported a case in a female 45 year of age whose peritoneal cavity was filled with fluid. After the fluid had been aspirated a large solid tumor not attached to the uterus was felt in the left lower abdomen. At laparotomy a myoma weighing 12 pounds was removed. It lay behind the peritoneum and took its origin from the posterior rectal wall.

In the well advanced cases obstructive symptoms with bleeding and foul stools are the outstanding symptoms. These patients often develop a marasmus or cachexia not unlike that due to malignancy and with the finding of a large ulcerating fixed mass a diagnosis of inoperable carcinoma or sarcoma is made. The long history should suggest the presence of a myoma and a microscopic examination should establish the diagnosis.

#### TREATMENT

Since leiomyomata are benign tumors a thorough local removal should lead to a cure. In the external type due to the rather broad base it may be necessary to resect the portion of the gut from which the tumor takes its origin. In my case it was comparatively easy to enucleate the tumor but it seemed unwise to resect only the area of attachment for fear of stenosis of the gut. When the tumor is not large or when the base is small it is quite possible to resect the attachment and close the defect in the gut wall by suture. The internal variety must be treated according to the location and the nature of the complicating pathology. Since practically every tumor

has a pedicle the bowel may be incised and the pedicle removed by a wedge shaped excision even ligation with cautery may be sufficient. In the presence of intussusception the type of operation will depend upon the viability of the gut and the condition of the patient.

Rectal myomata offer the most technical difficulties. Small pedunculated polyps can be removed with a snare and the stumps cauterized. The large external type are exceedingly difficult to remove. Several approaches are available viz the abdominal route when the tumor is very large and high with the base of the tumor accessible from within the abdomen. When the tumor is very large and fills the pelvis it may be next to impossible to gain entrance to the pelvis and enucleation may lead to profuse bleeding which further complicates the operation. Berg used a modified Kraskie technique with success. The method employed by Senn has much to be recommended. He ligated the rather broad pedicle in three parts and removed the tumor then excised the base and sutured the defect in the gut wall. The patient recovered.

#### CONCLUSION

In conclusion I wish to reiterate and emphasize that smooth muscle tumors of the intestines although not common do occur frequently enough to be considered in the differential diagnosis of abdominal tumor and intestinal obstruction especially intussusception when the attacks tend to be spontaneously relieved only to recur again from time to time. Moreover they must be considered in the differential diagnosis of large fixed ulcerating and obstructing growths of the rectum.

#### BIBLIOGRAPHY

1. BECK, F. Fall. n. Myoma ect. R. p. p. d. h. g. l. S. aph. e. l. a. t. St. kholm. 89. p. 5.
2. BOHRA, P. P. Medic. Pat. 12. 7. 8. 4.
3. BOHRA, P. P. Lang. Bemerku. gen. b. r. d. mm. m. Ar. h. f. p. th. A. t. 836. c.
4. BOHRA, P. P. h. u. Myoma kom. d. M. ge. neb. t. k. d. e. n. My. r. kome. de. Leb. A. ch. f. p. th. A. t. 836. c. 7.
5. F. ERSTER. F. br. id. d. r. M. 1. is. d. Neum. Arch. f. p. th. A. t. 183. 8. c. 7.
6. G. O. V. d. H. r. t. z. Ueb. r. mal. g. L. my. m. d. s. I. test. alt. akte. B. it. path. Anat. 909. IV. 89-109.

- 7 GOTTSCHALK Ueber die Histogenese und Aetiologie der Uterusmyome Ztschr f Geburtsh u Gynaek 1893 xvii 165-176
- 8 HANSEMAN Ueber einige selten Geswuelste des Magens Verhandl d Gesellsch deut ch Naturf u Aerzte 1896 ii 2-8
- 9 HEURTFAUX Myome du rectum Bull Soc anat de Nante Nov 1887
- 10 KLEBS Handb d path Anat 1876 886
- 11 KUKULA Retrograde Incarceration durch einen getielten Tumor de Duennndarm Wien klin Rundschau 1895 xx
- 12 LANGERHANS Demonstration eines Praeparate von Myoma lae icellulare malignum Berl klin Wehnschr 1893 338
- 13 LUBARSCU Hyperplasia und Geswuelste Ergebn d allg path Morph u Physiol 1895 ii 330 1897 50
- 14 MYKOWSKI Praeparate von Myommetastasen in Lungen Leber und Muskeln Muenchen med Wehnschr 1901 xlviii 1335
- 15 PELLIZZARI Myoma of the intestine Ab tracted in Zentralbl f Chir 1875 223
- 16 ROESGER Ueber Bau und Entstehung des Myoma uteri Ztschr f Geburtsh u Gynaek 1890 xviii 131-144
- 17 STANN Intra peritoneal myofibroma of the rectum weighing 11 pounds successfully removed by laparotomy Weekly M Rev 1891 xxiii
- 18 STRLINER Ueber Myome des Magen Darmkanals Beitr z klin Chir 1898 xvii 1-112 407-440
- 19 VIRCHOW Die Krankhaften Geschwuelste 1864 iii 107 128
- 20 WESENER Ueber ein teleangiectatische Myom des Duodenum von ungewoehnlicher Groesse Arch f path Anat 1883 l viii 377
- 21 WINKLE Ueber Myome des Uterus in aetiologischer symptomatischer und therapeutischer Beziehung Samml klin Vortr 1876 xcvi 735-764
- 22 WOELFLER Case reported by Sturmer
- 23 ZEIT Personal communication

TUBERCULOSIS OF THE EPIDIDYMISS<sup>1</sup>

A CRITICAL REVIEW BASED ON THE STUDY OF NINETY FOUR CASES

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THIS paper is based upon a careful review of 94 cases that have been under the author's personal observation. Special attention or special analysis was given to the end result obtained as far as this was possible. Large series of cases dealing with ultimate end results are rare and among papers including a large series of cases may be mentioned those of Barney, Keve, Schoonover, Barbilian and Soderlund.

No attempt has been made to review the literature exhaustively or to discuss in detail the different forms of treatment recommended by the various authors but rather to present data available in a series of cases under personal supervision.

There seems to be a general tendency at the present time to study end results obtained in various surgical diseases. Heretofore papers dealing with end results have been very few and far between. The papers for a long time dealt chiefly with the problems of diagnosis and differential diagnosis as well as with surgical technique. It is needless to discuss the various factors which have stimulated the medical profession as a whole and the doctor as an individual to survey his accomplishments in order that one might determine exactly just what has been accomplished by one or another form of treatment. Often it is true various types of lesions occur so infrequently that one is not in a position to command a survey of a large number of cases. In these circumstances the criticism that a study of a small group does not suffice is more or less justifiable but if a sufficient number of papers are reported even though the number of cases studied which deal with end results is small the data which accumulate cannot be other than worthwhile.

Tuberculosis of the epididymis represents a type of lesion which occurs so infrequently that papers dealing with a sufficient number of end results have been exceedingly few and far between.

## AGE

The general belief that tuberculosis of the epididymis is a disease that occurs in early adult life is verified by the data in the present series of cases. There were 4 patients in this series under 10 years of age. The youngest patient was 17 years old and the oldest was 65 years old. In each decade between these two extremes cases were recorded. The largest number of cases that occurred in any one decade was 37 in the third decade or 39.3 per cent of the total number of 94 cases (Table I).

TABLE I—AGE OF PATIENTS

Age	Case
Under 10	4
10 to 19	8
20 to 29	37
30 to 39	9
40 to 49	
50 to 59	3
60 to 69	
Not stated	—
Total	94

Barney has had an unusually interesting experience with this disease in children. He recently reported a series of 11 cases in children between 9 months and 14 years of age. Barbilian in his series of 145 cases reported 19 patients between the ages of 15 and 20 years.

## TRAUMA

The question as to whether or not trauma is a factor in the development of tuberculosis of the epididymis has been under discussion for a long time. Some years ago the question was of purely academic interest but today it has a new interest namely an economic one because of the Workmen's Compensation Acts and the problem of fixing liability. Not uncommonly patients state that their trouble followed an injury sustained during their employment and the cases are brought before an industrial board. The relationship between tuberculosis of the epididymis and trauma sustained during work is therefore a most important one.

In a recent paper by Cathcart the relation ship between muscular strain and tuberculosis of the epididymis is exploited emphasis being given to the medicolegal aspects of the subject. In Cathcart's case the patient was suffering from tuberculosis of the epididymis and sued for compensation on the ground that the disease had arisen after a severe strain in the course of his work. The decision in this case turned upon the answers to two important surgical questions. The first and crucial one was whether or not a severe muscular strain of the abdominal wall can within an hour or two set up an acute orchitis and epididymitis apart from any direct injury to the parts and in the absence of any gonococcal infection of the urethra. The second was whether or not such an attack of acute inflammation could be the exciting cause of subacute tuberculosis of the affected parts.

Cathcart concluded that acute orchitis and epididymitis may be caused by severe abdominal strain without gonococcal or other organ ismal infection of the urethra or the parts affected, that the acute inflammation is sometimes the result of torsion of the cord and that the acute orchitis and epididymitis thus produced may end (a) in an active tuberculous affection of the epididymis either by exciting a latent focus of tuberculosis or by giving rise to the conditions suitable for the development of a new focus or (b) in complete atrophy of the testicle. In the case that formed the basis of Cathcart's paper the sheriff ruled that the claimant had not proved his case.

Trauma as an etiological factor may be classified under the following headings: (1) direct (2) localizing and (3) mobilizing.

1 *Direct trauma*. By this is meant the direct implantation of tubercle bacilli into the epididymis. This probably never occurs in the production of the disease and is more theoretical than real hence should not be considered as a factor.

2 *Localizing trauma*. A number of authorities believe that the role played by trauma is purely one of localizing the tubercle bacilli hence a definite period of time must elapse between the injury and the development of the disease. One of the fallacies of this theory in its application to a given case is the great

variation in time between the injury and the onset of the disease. In the present series there were 30 cases in which there was a history of trauma, 47 cases in which there was no history of trauma and in 17 cases the records failed to state this point.

For years the theory of localizing trauma has had many adherents. As a result of the injury to tissue following the trauma its resistance is so greatly reduced that a *locus minoris resistentiae* results and a suitable landing place is effected for the tubercle bacilli circulating in the blood stream. The local hæmorrhage and the presence of necrotic tissue provide a suitable culture medium. The absorption of bacilli is hence interfered with because of the interference with the blood and lymph circulation following the trauma. The weak point of this theory is the fact that nothing is known of the condition of the testicle and epididymis prior to the injury.

Many authors refuse to accept the explanation in regard to localizing trauma among them Cathelin, Jeanbreen and others who hold that the tuberculous process was present in every instance at the time the injury was received.

3 *Mobilizing trauma*. Many clinicians believe that the question of trauma is concerned purely with a mobilizing trauma and that the injury either direct or indirect reaches a focus of tuberculosis heretofore not recognized hence its presence has not been revealed. The trauma causes an acute flare up or causes the tuberculous process already present to become worse. For example a well developed tuberculous process is discovered in an epididymis immediately after an injury in which case the trauma simply served as a means of recognizing the tuberculous process. These views are subscribed to by many clinicians notably Cathelin, Jeanbreen, Morton and others.

In the light of these various theories it is interesting to note the statements made by patients from the standpoint of time that had elapsed between the injury and the onset of the disease. In one instance there was an antecedent history of an injury to the right testicle 18 years before the patient came under observation and 6 years later the testicle was

removed for tuberculosis. In another case the patient fell and injured the right testicle 17 years before and the testicle was removed 1 year after the injury. In another case the patient fell from a tree and injured the left testicle which subsequently underwent abscess formation. There were 24 cases in which the patients gave a definite history of injury to the testicle which became the seat of tuberculous disease. Unfortunately a history of trauma was not elicited in many of the early cases.

Another factor namely the various types of injury which preceded the development of the tuberculous disease is of interest. Because of the possible medico-legal aspect of this question in connection with the Workmen's Compensation Acts the chief types are listed.

*Types of injuries mentioned as preceding the onset of the disease.* fell at work, pinched by trousers, strain from moving machinery, struck with pick handle, fell from a tree, hit by box, injured in football game, strain in pulling cable, dog jumped at patient, fell astride a log, throwing bales of hay, shrapnel wound over thigh, hit testicle and later ran for a car, fell on a truck, taking child on lap, gunshot wound in hip, kicked in hip, playing when a child fell off hay loft. In other cases only an indefinite statement regarding strain such as that due to heavy lifting, etc. was made.

#### PRIVICUS VENEREAL DISEASE

In view of the fact that tuberculosis of the epididymis may be confused with syphilis and that differentiation from syphilis is necessary, it is interesting to note that there was a positive history of syphilis in only 5 cases. The early cases have no record of any Wassermann tests, but the late case, because the Wassermann test has been done in recent years as a routine measure, have a record. In this series there were 45 cases in which Wassermann tests had been made, but in only 5 cases was a positive reaction reported and in these cases syphilis was only an incident, since the histological examination showed that the process was fundamentally due to tuberculosis and not to syphilis.

In all probability gonorrhœa plays a less important rôle than was formerly supposed. Certainly a large number of patients develop tuberculosis of the epididymis who have never had gonorrhœa. In this entire series there were only 27 cases that gave a history of an antecedent attack of gonorrhœa. A history of a previous attack of epididymitis was obtained in 25 cases. In some instances this occurred during a gonorrhœal infection and in some it occurred in the absence of a recent gonorrhœal infection, as far as it was possible to determine. In the latter type of case the epididymitis may have been due to an old nonspecific seminal vesiculitis.

This part of the patient's history should be gone into carefully and all statements should be accepted or rejected according to their value. Thus in a given case in which the patient states that he had a previous attack of epididymitis, one must determine if possible whether the attack was secondary to an old seminal vesiculitis or whether it was a tuberculois of the epididymis that had subsided and had remained dormant until recently fanned into activity.

On the other hand a condition much more difficult to interpret may be encountered in which a patient with a latent tuberculosis of the epididymis, which is not known or recognized by him, acquires a gonorrhœal infection during the course of which he develops an epididymitis. If a gonorrhœal infection is superimposed upon a tuberculous infection it may be the direct underlying reason why the tuberculous infection is not at first recognized. The only possible differentiation then is the unusually prolonged course of the supposed acute gonorrhœal epididymitis. One of our cases presented this picture and the situation was confusing for a short time.

#### ROLE OF PHYSIOLOGICAL CONGESTION

It is generally admitted that the largest number of cases of tuberculosis of the epididymis occur between the ages of 20 and 40 years, the period of life when there is the greatest sexual activity and a corresponding increase in the blood supply. Whether or not this factor plays any decided rôle is still an open question.

# PRESENCE OF TUBERCULOSIS ELSEWHERE IN THE BODY

In view of the fact that it is generally assumed that tuberculosis of the epididymis is always a secondary process it behooved us in studying our cases to search very carefully for the presence of tuberculous disease in other parts of the body.

Nothing is so important as an aid in establishing a diagnosis of tuberculosis of the urinary or genital tract as the elicitation of a good accurate history. From the history one often obtains information relative to previous attacks of tuberculosis in other organs or in a history of surgical operations for tuberculous disease and finally the patient may volunteer the statement of being under treatment at the present time for tuberculosis elsewhere in the body.

*Extrapulmonary tuberculosis* In the early cases in this series not enough emphasis unfortunately was placed upon this part of the history and some of the records do not mention anything about antecedent tuberculous disease. In a review of this series however evidence of antecedent tuberculous disease was obtained in 15 cases with the following distribution: tuberculosis of the kidney in 10 cases of the kidney and hip in 1 case of the spine in 2 cases of the shoulder in 1 case and of the glands in the neck in 1 case.

*Tuberculosis of the lungs* In all of the later cases great emphasis was placed upon trying to determine whether the patients had any evidences of pulmonary tuberculosis. In some of the cases it was rather easy to obtain a history of antecedent tuberculosis such as protracted cough, night sweats or a history of pleurisy. Particular stress was placed upon this point so as to determine lung involvement and it was interesting to note that in a certain number of cases the internist had declared the lungs negative and the roentgenologist had reported the evidence of an old healed tuberculous disease. Nevertheless the most important point is to determine whether or not there is lung involvement. Whether the diagnosis is made by one or both methods is irrelevant.

If we include in one group cases in which the diagnosis of pulmonary involvement was

made both clinically and roentgenologically we find that in 75 cases or 79.8 per cent either the clinical or the X-ray examination showed evidence of tuberculosis either active or healed. Involvement of the bones was found to be present in 4 cases: the spine in 2 cases, the shoulder in 1 case and the hip in 1 case.

## RECTAL FINDINGS

The information obtained in this series by means of rectal examinations agrees in the main with the conclusions reached by Barney and others in connection with this phase of the subject. The value of the rectal examination must always remain subject to a certain amount of criticism. If the rectal examination is positive, well and good, but on the other hand a negative rectal examination does not necessarily mean that there is not a small focus of tuberculosis either in the prostate or vesicles. It is obvious how one might miss a tuberculous nodule in the prostate or vesicles on rectal examination under certain circumstances.

The statistics of Cunningham, who autopsied a large series of cases, are of interest. In his series of 4250 autopsy records he found 35 instances of tuberculosis of the epididymis and in 25 (nearly 71.4 per cent) of these the prostate and vesicles were involved. In his series of 86 clinical cases 49 (nearly 57 per cent) gave positive findings.

It should be remembered that frequently an early examination may prove negative while a later one may disclose evidence of associated disease at this point. In our 94 cases there were 85 in which the results of the rectal examination were recorded but in 9 cases this information is lacking. Of the 85 cases there were 70 in which the records showed positive changes in the prostate or the seminal vesicles or in both. Naturally the largest number of positive cases occurred late in the course of the disease. If we reduce the number of positive rectal findings we have 82.35 per cent of positive findings. These figures tally with those of Barney. In his series of 101 rectal examinations of patients with tuberculous epididymitis he recorded the prostate as being tuberculous in 76 cases.



or 75 per cent I believe that his estimate of 75 per cent is conservative

### ONSET

By far the largest number of patients with tuberculous epididymitis had a slow gradual onset and the disease as a rule began long before the patients came under observation. Often the patient had no pain and discovered a nodule quite by accident or often the nodule was discovered during a routine physical examination so that the patient was unable to say just when the tuberculous process began. On the other hand in many instances a very definite date of onset was given (Table II).

TABLE II — ONSET

D in y	m	Cas
0	1	5
3		3
4		6
6		
9		
8		
Not stated		6
Total		94

### SIDE INVOLVED

It is the general consensus of opinion that tuberculosis involving one epididymis is followed sooner or later by an involvement of the opposite side so that eventually both sides are the seat of the tuberculous process. In this series of 94 cases there were 37 in which there was a subsequent involvement of the opposite side or reduced to terms of percentage equals 39.36 per cent. Barney in his series found that in 41.6 per cent the opposite side became involved. By means of a very careful survey of this series and by personal examination of the patients or where this could not be done by personal correspondence it was found that there were 48 cases in which no subsequent involvement of the other side took place and 9 cases in which no statement relative to this question was obtained. There were 4 cases in which there was bilateral involvement when the patients presented themselves for examination and in which the

process began on one side and these added to the 33 that had involvement of the other side makes the total number of bilateral cases 37 or 39.36 per cent. It is very interesting in the study of the question of involvement of the opposite side to note the large number of cases in which this involvement took place rather early. In this series involvement of the other side occurred in 15 cases during the first 6 months and after 6 months in 17 cases. No time was mentioned in 5 cases. There does not seem to be much difference regarding the sides involved. In 48 cases the patients presented involvement of the right side in 41 cases of the left side in 4 cases of both sides and there was no record in 1 case.

### SYMPTOMS

It was to be expected that these patients would have more or less pain. As a rule the pain was referred to the testicle but strictly speaking it was not limited to the testicle. In 16 cases in this series it was referred to as being along the cord and in 8 cases it was referred to the groin. Some of the patients complained of pain in the thigh and occasionally in the crutch. Therefore too much dependence should not be placed on the patient's statement with regard to the location of the pain.

*Urinary symptoms.* Early in the course of this disease there was rarely if ever a reference to urinary symptoms. Thus in 43 of the 94 cases in this series or 45.7 per cent there were no urinary symptoms. Gradually however many patients complained of various urinary symptoms. The urinary symptoms depended in part upon whether the tuberculous process began in the epididymis or in the kidney. For example when the tuberculosis of the epididymis followed a tuberculosis of the kidney many of the urinary symptoms were due to involvement of the bladder and often the symptoms of tuberculous cystitis were present before the onset of the tuberculous epididymitis but when the patient reported for examination for tuberculous disease in the epididymis he would naturally mention the fact that he had urinary symptoms. In another group of cases in which there was no higher involvement in the urinary tract and

in which instance the urine showed only a few leucocytes urinary symptoms were present due no doubt to manifestations of tuberculosis in the prostate or in the seminal vesicles or in both. In some of these cases more than one urinary symptom was present. Table III shows the most frequently mentioned symptoms.

TABLE III—SYMPTOMS

	C
Frequency	42
Hæmaturia	23
Burning	22
Painful urination	21
Backache	1
Fever	10
Urgency	9
Difficulty	8
Incontinence	4
Dribbling	3

**Urinalysis** The urinary findings in this series of cases are extremely interesting in that they show the presence of abnormal elements in the urine in a large number of cases. The presence of pus in the urine varied within rather wide limits. In some of the cases in which the tuberculous process in the epididymis was secondary to an advanced urinary tuberculosis the patient had urinary findings of much more serious moment than were found in the cases before there was much involvement of the urinary tract. The striking thing about reviewing the urinalysis in this series is the fact that in 72 of the 94 cases some pus was found. Table IV shows the results of the urinary examination.

TABLE IV—URINALYSIS

	C
Pus	72
Albumin	30
Red blood cells	23
Bacteria	9
Ca ts	
Tubercle bacilli (either on smear guinea pig inoculation or both)	13

#### ABSCESS FORMATION

In a certain number of instances the tuberculosis progresses and abscess formation occurs. In this series of 94 cases abscess of the epididymis was found in 30 cases. Often the abscess ruptures externally or is opened surgically and a scrotal fistula results.

#### VAS DEFERENS

One of the diagnostic points that has been mentioned from time to time is the condition of the vas deferens the statement having been made that unless there is some evidence of pathological changes in the vas deferens the patient does not have tuberculosis of the epididymis. This probably is a good clinical rule to follow since in 94 cases in this series 55 had involvement of the vas deferens. In 63 cases in which this point was mentioned it was positive in 55 cases or 87.3 per cent negative in 8 cases and in 31 cases was not mentioned. It may be that the percentage of cases in which there was involvement of the epididymis was higher than is apparent from these figures. There can be little doubt as to the fact that if a tentative diagnosis of tuberculosis of the epididymis is made and the patient does not present involvement of the vas deferens one should be cautious in making a diagnosis of tuberculosis. Failure to heed this advice in one case led to the wrong diagnosis a diagnosis of tuberculosis of the epididymis was made and attention was called to the fact that the vas was not involved. This should have cautioned us to change our diagnosis but we did not. At the operation a tumor of the testicle was found. Barney in a paper read at a meeting of the American Association of Genito Urinary Surgeons has already called attention to the confusion in this differential diagnosis.

#### SCROTAL FISTULA

As is well known one of the diagnostic points in favor of tuberculosis is the presence of a single fistula or multiple fistulae in the scrotum which are either unilateral or bilateral. Not uncommonly the patient states that these fistulous tracts discharge purulent fluid for a while close and then reopen. In this series fistulae were found in 33 cases none was found in 54 cases and in 7 cases no record was made as to their presence. Hydrocele fluid was found present in 18 cases.

#### END RESULTS

Of great interest as mentioned previously in this paper are the ultimate end results because of their importance from the stand

TABLE V—LATE CAUSES OF DEATH IN CASES OPERATED UPON

Tube cul u m g t	5
P l m r y t l l	4
M d v t b l	
Tube ul of g t u arv ga	
I l y t leu foll w g p at fo pl	
t m v y 8 m th l te (p t ntop t d p	
l ewh )	
Tub l p t t	
A d t	
C u e k w	
Tot l	6

TABLE VI—LATE CAUSES OF DEATH IN CASES NOT OPERATED UPON

M l r y tube l	3
T b l m g t	
Pulm t b ul	
Pe r m u	
N ph t	
Unk w	
Tot l	—

TABLE VII—DURATION OF LIFE AFTER OPERATION IN PATIENTS NOW DEAD

y	
L th n	5
t	4
3 t 4	
4 t 5	4
T t l	6

TABLE VIII—DURATION OF LIFE AFTER EXAMINATION IN PATIENTS NOW DEAD AND NOT OPERATED UPON

y	
L tha	4
3	
N p t	—
T t l	—

point of prognosis After a diagnosis of tuberculosis has been established what may the patient look for from the standpoint of life expectation? This question has been of interest not only to the patient and his family but for the life insurance company as well After a diagnosis of tuberculosis has been made what sort of a rating should the patient receive from the company?

TABLE IX—DURATION OF LIFE AFTER EXAMINATION OF PATIENTS NOW LIVING AND NOT OPERATED UPON

		C
y		1
/		1
4		1
5		1
7		
1 t l		6

TABLE X—DURATION OF LIFE AFTER OPERATION IN PATIENTS STILL LIVING

y		C
o nd		7
3		5
4		4
5		7
6		6
8		3
9		9
T t l		3
		5

3		
4		
5		
T t l		57

TABLE XI—CONDITION OF PATIENTS NOW LIVING WHO WERE OPERATED UPON

No ympt m		36
Bl dd mpt m		5
D l p d tube ul sof k d y d p		
D el p d p l m n r y tub lo		
D el op d t b l s of k d n y		
De l p d a u wh h t l l d n n g		
S cond de b m l ed y ft p t		
N ympt m		
Se nd d b m n l d ye ft ope		
t a d pe at d		
S l v fte p to l t u e f m and		1
U l g Bl d p u o-8		
U l middle of P p t l g m t		
I t S u both d		
D l p d t b ul of b th k d d bl dd		
Sympt m ha t ub d d		
P p t d well ye ft p t n		
U d r b to (l t c )		3
L g b t n p t o d t		—
T t l		57

In reviewing the cases a study was made to determine whether or not patient who were operated upon lived longer than those who were treated without surgery whether the

patients who were operated upon had different deaths from those who were not operated upon and finally to determine the cause of death

In this series 78 patients were operated upon and of these 78 patients 16 are dead and 57 are living. The results in 5 cases are not known. There were no immediate deaths but the conditions causing death occurred at varying periods after the patients left the hospital (Table V). The three most frequent causes of death in this group are tuberculous meningitis, pulmonary tuberculosis and miliary tuberculosis.

In the fatal cases not operated upon although the total number is only 8 we see a somewhat similar but not exactly parallel cause of death (Table VI). The two most frequent causes of death in this group are miliary tuberculosis and tuberculous meningitis while in the other group the two most

TABLE VII—CONDITION OF PATIENTS NOW LIVING AND NOT OPERATED UPON

		Ca
Treated with tuberculin	No symptoms	3 1 — 6
No treatment	No symptom	
No treatment	No improvement	
Total		6

frequent causes were tuberculous meningitis and pulmonary tuberculosis.

One patient who died 16 days after epididymectomy had a very advanced case of pulmonary tuberculosis. He was operated upon under local anæsthetic for multiple fistule which were discharging great quantities of pus. The operation was principally undertaken for the purpose of giving the patient some degree of comfort.

One of the patients not operated upon lived 11 years after the diagnosis of tuberculosis of the epididymis had been made. He finally died of pernicious anæmia (Table VIII).

## THE DIFFERENTIATION OF THE REDUCING BODIES IN THE URINE DURING PREGNANCY

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F m b D p a t m f M d l O b t r U t y f M y l d

**I**N clinical laboratory work urines are frequently brought to the laboratory with the statement that a reducing body has been found and a request is made for a decision as to the type of carbohydrate which is present. These requests seem to come most often from the obstetrical service since it is occasionally of clinical value to determine whether or not the reducing substance is glucose or lactose.

An analysis of the situation shows that the obstetrician really desires the answer to certain questions: (1) is the reducing body a sugar; (2) if it is a sugar is it glucose or lactose; and (3) if the sugar is glucose is the patient a diabetic or is she suffering from only a harmless glycosuria?

The last question is really the only one of importance. If the patient is a diabetic she must be treated as such. All the other conditions can be ignored. Fortunately, true diabetes in pregnancy is rare but it is extremely important to pick out the occasional case.

The first question is the most difficult to answer in a hospital laboratory since a number of non-carbohydrate reducing substances may be present and the exact structure of most of these is not known. As a rule therefore the first question is answered by exclusion after the second and third are solved. If one can exclude glycosuria and lactosuria and the reducing substance is present in small quantities the assumption is that we are dealing with a non-specific reduction.

In attempting to answer the second question we also run into many laboratory difficulties. When we examine methods available for the identification of the type of carbohydrate in urine we find that there are only two which are practically applicable in the clinical laboratory—the fermentation and the phenylhydrazine test. Both of these tests are subject to certain very definite limitations which must be clearly understood by the clinician in the interpretation of the results. It should be realized that from these two tests the laboratory cannot absolutely identify the type of carbohydrate but can give only an approximate result.

First, only one strain of yeast has ever been identified which ferments glucose exclusively without splitting some other carbohydrate and this culture has been lost. Second, yeast also contains a decarboxylase which at times can split the amino acids present in urine with the production of gas. Again bacteria may be present which will split lactose to galactose and glucose and thus allow the latter to be fermented by yeast. Galactose itself is fermentable to a small extent. In addition the quantity of the yeast and the time during which it acts must be regulated since the respiration of large quantities of yeast may form some carbon dioxide from glycogen. Finally, some samples of yeast may contain a small amount of diastase and this acting upon the constituents of yeast may produce a minute amount of sugar at incubator temperature.

In the case of the phenyl osazones it is not possible to make an absolute identification from the morphology alone. To be sure of the osazone it is necessary to make an accurate determination of the melting point and since the melting points of the common osazones lie close together this is a matter of considerable difficulty and beyond the scope of the ordinary hospital laboratory. In urine the colloids which are present often prevent the formation of the osazones entirely or alter their morphology. This is particularly true as regards lactose. It should be remembered also that levulose which is sometimes found in urine gives the same osazone as glucose.

In view of these various uncertainties it seemed desirable in order to determine just how reliable or unreliable are the reports from the laboratory to evaluate more carefully these two methods both from the standpoint of the laboratory and from the standpoint of the clinician.

It should be realized that from these two tests the laboratory cannot absolutely identify the type of carbohydrate but can give only an approximate result.

point of performing the test and of correlating the results with the clinical findings in a series of cases

At one time every obstetrical patient in the University Hospital had a routine urinalysis once a week. Each specimen of the urine which showed a yellow precipitate with Benedict's solution was taken to the central laboratory for further test. Specimens which showed only a greenish color without a yellow precipitate were discarded. During this period 556 specimens were examined and of these 160.8 per cent showed a yellow precipitate and were further examined. A comparison of the results of the tests was made with the clinical condition of the patients particularly with regard to whether they were secreting milk or colostrum.

Host has made a careful study of the various techniques employed for these two tests and has developed a new standard technique which we have used throughout our work. It should be understood that our results should be considered as results secured only with this technique. Host showed that the test carried out with phenylhydrazine hydrochloride is less sensitive than with phenylhydrazine since from  $\frac{1}{2}$  to 1 per cent of glucose must be added to normal urine before it is positive with the former reagent while the phenylhydrazine will secure positive results with concentrations of from 0.1 to 0.2 per cent of glucose in urine. The details of the methods are given below.

For the fermentation of urine bring the hydrogen ion to 5.5 or 6.8. This is best done by testing with bromo-thymol blue against the Clark standards. The reaction can be adjusted if necessary by the addition of tartaric acid or sodium bicarbonate. Boil the urine to kill organisms which might affect carbohydrates. Cool then add fresh yeast so as to make an approximately 5 per cent suspension. Host recommends reading after 48 hours in the incubator. We have found that incubation for this length of time results in a large number of non-specific fermentations and believe that the period of from 12 to 24 hours which is more commonly in use in this country is more accurate. As a matter of fact if large quantities of glucose are present gas is formed in a very short time.

For the phenylhydrazine test place about 4 cubic centimeter of urine in a test tube and add 1.5 to 2 cubic centimeters of a saturated solution of sodium acetate in 50 per cent acetic acid and 3 drops of phenylhydrazine. This is brought to the boiling

point and the tube is then put in a water bath at 100 degrees C for about an hour. The test tube is allowed to remain in the water bath so as to cool slowly and is not examined microscopically until the next day.

We have found the widest variation in the morphology of the osazones particularly the lactosazones and it was only because we had seen so many intermediate forms that we were able to identify them in some of the specimens. The small ray like fibers characteristic of lactosazones tend to disappear leaving small round dark globules with a smooth rim.<sup>1</sup>

The physiological osazone described by Host was observed in a few cases but all of these occurred early in the series and none was seen later. Some minor changes in technique or seasonal change in diet seems to be an added factor in their production.

Osazones of unknown type were seen in 5 urine specimens of lactating women. Two of these were irregular sheaf of wheat forms and these might possibly have been atypical glucosazones. In one the osazone appeared much like sunflowers with regular dark centers and long broad regularly arranged rays. In another regular light brown bodies with out spicules were seen. The e were quite similar in morphology to a group of osazone which were produced by testing the non fermentable residue of molasses. Still another specimen showed many small dark osazones arranged closely together like bunches of grapes but without any spicules or projections.

Matthews has recommended a rapid method of fermenting urine by the use of much larger quantities of yeast acting over a shorter time. We have tried this method on other occasions and found it satisfactory but in specimens such as those in this series when only small quantities of reducing substance are present it gives non specific results since the reducing body in the urine is destroyed by yeast. Thus in specimens from 15 patients which showed no fermentation by the ordinary test the Matthews test destroyed all of the reducing power in 12 thus pointing to the presence of glucose. The reducing power remained after fermentation in 2 and was doubtful in 1 case.

M h fth tech l w k c c t o w th p p e a d  
by D W S Sc tt d M Ad m Sacz k Th final d g i  
po t h we w ll mad pe sonally by fth th

TABLE I.—COMPARISON OF TEST OF CARBOHYDRATE WITH PERIOD OF LACTATION—ONE HUNDRED AND SIXTY CASES

			La	( )	m	La	N
I	f	ll	m				
	N		I	I			
		I					
II	N		II				
	I		I				
	N						
		I					
		I					
		II	I	I			
		N					
	I						
	II	I	I	II			
	U	k		II			
	I	I					

Cambridge believes that by absorbing the lactose from urine with a high grade of blood charcoal lactosazone can be more easily obtained. In a case in which no osazones were found by the ordinary technique none was found by the charcoal method and in 1 case lactosazone was found by the ordinary method and not by the charcoal method.

Only few glycosurias occurred in our series so that the major portion of our work has been concerned with the identification of non fermentable carbohydrate. From our own observations in glycosurias in non pregnant cases and from the literature we can say that a markedly positive fermentation test under standard conditions usually means glucose. When only small quantities of reducing substance are present the difficulties of interpretation are greater. Thus it should be noted that in our series the urines of 2 patients showed glucose but they did not show more than a trace of fermentation. All glucosazones came from patients with glycosuria as there were no true diabetics in this series.

The formation of lactose by the body is intimately connected with the period of the formation of milk. Colostrum has also been shown to contain lactose in varying quantities.

Table I shows the results of a comparison of our findings arranged according to the period of lactation. It will be seen that in the group of non fermentable carbohydrate in only about one half of the cases could lactosazone be identified morphologically. The presumption is that most of these reducing bodies should have been lactose. Whether this group which did not form osazones represents lactose which cannot be identified because of interfering substances in the urine or some other type of non fermentable carbohydrate cannot be determined through this study but the former supposition is inherently more probable. An arrangement of the non lactating and colostrum cases is made in Table II chronologically in the course of their pregnancy. We had relatively few cases early in pregnancy.

We may conclude therefore that if a marked fermentation occurs we are probably dealing with glucose. If an osazone of characteristic morphology is observed it is probably fairly specific but other combinations of results are inconclusive. Therefore because of the technical difficulties which we have encountered in these two tests it would seem from the literature and from our findings that too much reliance should not be placed by the clinician upon them.

Fortunately certain clinical short cuts are of help in connection with this problem and may be used to avoid a great deal of unnecessary laboratory work. Thus Williams in the fermentation test has shown that glucose is found 5 times as commonly in the last half of pregnancy as in the first half and that a reducing body found during pregnancy is practically always glucose and not lactose. However during the period of breast engorgement lactosuria is present in a considerable proportion of nursing women. This is due to the fact that lactose is formed in the human body only during the period in which colostrum or milk is being formed in the breast. Our data in Table II (non lactating and colostrum cases) does not however support his general statement that not a single specimen taken during pregnancy showed the persistence of a sugar reaction after fermentation demonstrating that the sugar found in the urine during pregnancy is always glucose.

This discrepancy is probably due to the fact that Williams' series contains many cases observed during the early months of pregnancy while most of our cases were studied from the ninth month on. In fact only 3 of our cases showed neither colostrum nor milk in the breast. The 2 series should therefore be considered as a whole representing phases of the same problem. Thus as a ready rule of thumb it may be stated that a reducing body in the urine during pregnancy is lactose if the breasts are secreting and glucose if they are not particularly in the earlier months of pregnancy.

In answering the third question at the beginning of the paper as to the means of differentiating glycosuria from diabetes Host offers considerable help in his work in which he studied the glycosuria of pregnancy by means of the sugar tolerance test. He showed that early in pregnancy (from 1 to 3 months) the glycosuria is of the hæmic type that is there is no change in the renal threshold but there is some defect in the storage mechanism for glucose so that the blood sugar rises over the threshold and is therefore excreted in the urine. During the latter part of pregnancy on the other hand the blood sugar rise is usually small but the renal threshold is often so low that glycosuria of the renal type frequently occurs.

After the determination that the reducing substance is glucose the next step in the differentiation of a glycosuria from a case of diabetes consists in the estimation of the fasting blood sugar. If this is elevated it points to the presence of diabetes. If it is normal a glucose tolerance test is necessary for final differentiation. Since this is costly in time and money both to the patient and to the hospital it should be used in as few cases as possible. Clinically a patient with glycosuria particularly if it is not more than a few grams in 4 hours who has no diabetic symptoms such as polydipsia or polyuria who has lost no weight who has no acetone bodies in the urine and who has a normal fasting blood sugar can be considered for all practical purposes to be non diabetic. This is particularly true in cases in which the glycosuria clears up after delivery.

TABLE II — COMPARISON OF TYPE OF CARBOHYDRATE WITH DURATION OF PREGNANCY — NON LACTATING AND COLOSTRUM CASES

	1st d l y			2nd d l y		
	At m	10 30	1 30	At m	1 30	At m
F m b m						
Os						
Gl						
N t f m t b l i m						
Os						
T t t d						( 1 wk )
N						( 1 wk )
O — L t						( 8 wk )
O — Gl						( 8 wk )
O — Ph 1 g 1						( 8 wk )
M t t						
1 h y 1 g 1 d l t						
T t l						

We may say therefore that in the majority of cases

1 A reducing body found in the urine of a pregnant woman during the period of breast engorgement is probably lactose rather than glucose

2 A reducing body found in the urine of a pregnant woman during pregnancy and before the period of breast engorgement is probably glucose rather than lactose

3 Glucose found in the urine during pregnancy is almost always due to a glycosuria of renal or hæmic type rather than to a diabetes

#### SUMMARY

1 Twenty eight per cent of a series of urines from pregnant women showed reduction by the Benedict test

2 Osazones of unknown type occurred in 5 cases

3 The fermentation test according to the method of Host gives more specific results than does that of Matthews



4 The durocol method for fixing lactosazone was not successful in the few cases in which it was employed

5 In only about one half of the non fermentable specimens was it possible to isolate lactosazone. These came from patients with both milk and colostrum in the breast and from non lactating patient

6 Certain clinical rules are given which seem to be sufficiently accurate to follow in the average case and the laboratory work should be ordered only in the occasional difficult case and then accepted with a certain amount of reserve a negative hydrazine test

may mean only some interference with the formation of visible crystals of lactosazone

# BIBLIOGRAPHY

1. C. A. T. I. J. A. d. Hov. RD. H. A. N. d. l. t. m. l. tu. O. f. rd. Med. cal. P. bl. t.
2. 11. 9. 3. 63. 11. 1. C. b. l. v. l. t. t. le. p. e. m. q.
3. 11. m. 11. u. e. uk. l. it. r. l. a. t. o. to. blood. b.
4. J. M. I. e. s. 10. 3. 5. M. A. R. I. N. S. A. I. A. v. m. t. h. o. d. f. t. h. d. t. n. c. t. i. o. n.
5. W. L. I. t. J. I. S. m. e. b. r. v. a. t. o. p. o. t. h. g. l. y.

DANGERS IN THE POSTOPERATIVE USE OF INSULIN<sup>1</sup>

BY EDMUND ANDRIWS, M.D., I.A.C.S. AND ENRIK KUHLISKIOLD, M.D. CHICAGO

ALMOST immediately upon the discovery of insulin and its value in the treatment of diabetes attempts were made to use it in non-diabetic conditions. Within the last 5 years an enormous literature has grown up on the use of insulin in the treatment of various postoperative conditions and if the literature is any indication the use of insulin must be very wide spread in the surgical clinics today. There appeared in 1923 the pioneer work of Thalhimer (1). His work was elaborated by Fisher (11) in several reports tabulating 45 cases treated by this method. Subsequently others appeared to confirm the value of this treatment (10). Many patients were apparently benefited although the results were not uniform but as Fisher warned us certain untoward effects were observed. Therefore in this form of treatment the blood sugar level should be controlled much more carefully than in cases of diabetes.

A critical review of this literature in the light of modern medical knowledge of insulin action is to say the least not convincing. In the first place the whole rationale of this method is based on the early work of MacLeod (8), Banting (4) and especially of Ringer (19) on the standardization of insulin. Ringer's work on pancreatectomized animals showed that one unit of insulin will bring about the oxidizing of one gram of glucose based on the studies of the respiratory quotient.

The more modern viewpoint is that the action of insulin is much more indirect. The recent article of Erdie (15) and MacLeod (13) make it exceedingly doubtful that insulin is concerned in any manner with glycolysis. It has been shown beyond a doubt that the combustion of glucose within the muscle is not increased by the action of insulin *per se*. The actual physiological effect of insulin appears to be three fold:

1. It promotes the storage of glycogen in the liver.

2. It converts glucose into some other hexose more readily oxidizable.

3. It brings about an increased affinity of tissue for water thereby causing a concentration of the blood.

In two previous articles (3) it was shown by one of us that the action of insulin was enormously exaggerated and prolonged if the organism was markedly dehydrated. Doses of insulin which under normal conditions produced a slight fall (15 milligrams of blood sugar lasting for hours) would cause a profound and even dangerous hypoglycemia in dehydrated animals. The theoretical consideration of this phenomena are discussed at greater lengths in one of these papers.

## EXPERIMENTAL

With this point in view the action of insulin after operations was studied in a number of patients. Blood sugar estimations were made by Byrd's modification of Folin Wu. By this method blood sugar estimations can be made by 0.1 of blood and by making estimations every 15 to 30 minutes all the details of the curves become evident.

Ether anesthesia cases only were used. Twelve to eighteen hours after operation at the height of the reaction 10 units of insulin were given subcutaneously (Lillyletin units 5) and 25 grams of glucose.

*Curve 1* is a composite curve of the effect of 10 units of insulin and 2½ grams of glucose per unit (5 grams) in normal human beings. The result as can be seen is about a 15 milligram drop in blood sugar with a return to normal within hours. If the results of insulin and glucose after operation were comparable to this it would be a highly valuable procedure. However the dehydration which results from the starvation and the acidosis accompanying practically every surgical procedure results in a profound and dangerous hypoglycemia.

*Curve 2* illustrates this point. The insulin and glucose were given the morning after the

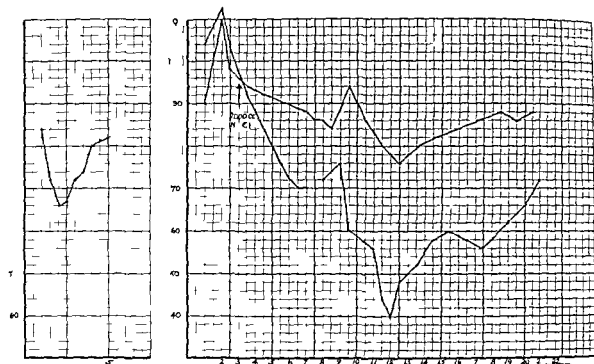


Chart 1 (left) Comparison of blood sugar level before and after operation. The y-axis is labeled 'mg' and the x-axis is labeled 'time'.

Chart 2 (right) Comparison of blood sugar level before and after operation. The y-axis is labeled 'mg' and the x-axis is labeled 'time'.

operation. The blood sugar was already low as a result of the 4 hour starvation. The resultant fall in blood sugar was rapid and profound. The injections had been given at 8 o'clock in the morning and by 1 o'clock in the afternoon it was 39 and the patient had begun to twitch. He was then rescued by the administration of glucose.

The other curve represents a similar experiment on a patient who had been flooded with 4000 cubic centimeters by hypodermoclysis and it will be seen that the insulin effect was light and transient.

Curve 3 represents a more accurately controlled experiment. Two curves are given of the blood sugar following herniotomies.

The conditions were identical except that one patient had no fluids except small sips by mouth. The other got very large amounts by proctoclysis and hypodermoclysis (4000 cubic centimeters). The intensity and length of the insulin action in the two cases is evident. The hydrated man had practically no insulin action. The other had a fall in blood sugar of 35 milligrams which lasted for 13 hours.

Curve 4 shows the practical abolishment of the insulin effect by the administration of 4000 cubic centimeters of saline following a slight operation.

The lower curve shows that the operation *per se* is not the factor producing this phenomenon. This patient had no operation. He was dehydrated for another purpose and it is evident that the insulin action is here very markedly exaggerated.

#### DISCUSSION

It is evident from these curves that the use of insulin and glucose in patients who are suffering from postoperative conditions and are therefore unavoidably dehydrated is a highly dangerous and useless procedure. It must also be remembered that in toxic conditions fluids are fixed by colloids and not available for physiological purposes and that the free water in the organism is therefore reduced even more than the total water. This condition (fixation of free water) is physiologically equivalent to dehydration. What these patients need is glucose and water.

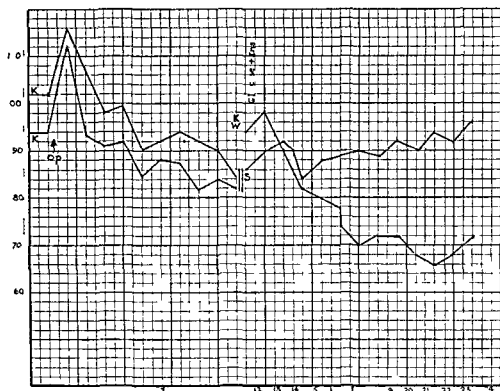


Chart 3 Curves showing blood sugar following hematomies

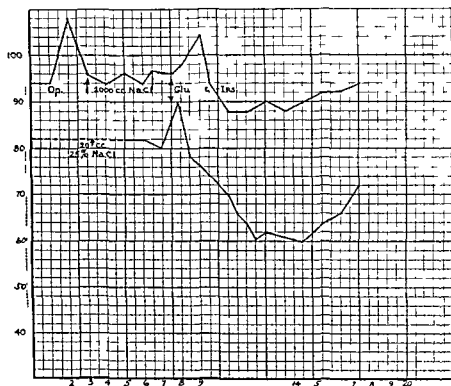


Chart 4 Abolishing the insulin effect by administration of 1000 cubic centimeters of saline after light operation

They are starved and thirsty and have a constant hypoglycemia and insulin not only does not produce any glycolysis but it tends to lower the already low blood sugar still further. This insulin hypoglycemia is not only marked but often reaches the danger point and the symptoms of hypoglycemia are so similar to many other postoperative complications that their recognition is exceedingly difficult.

In none of the previous reports and experiment on the use of insulin and glucose injections after operation was any careful estimation of blood sugar made such as was made in the case reported. One or at most two blood sugar estimations were made. It is very evident from a study of our curves how confusing such a procedure would be. In the first place the ether anesthesia produced a rise in the blood sugar of moderate intensity lasting for from 2 to 3 hours. In the next place an insulin injection itself produced a transient rise in blood sugar before the fall began. For these reasons the previous work on this subject cannot be considered of great value.

Another thing to be considered in such work is the so-called Iudero effect (9). If an organism receives glucose there is first a hyperglycemia. After this generally in a few hours there is a marked hypoglycemia lasting for several hours. This is due to the fact that the carbohydrate storing mechanism is speeded up by the high blood sugar and continues to overact.

Also to be considered in this connection is the effect of insulin is already mentioned of concentrating the blood. Following any operation there is often a passage of fluids and protein into the tissues and insulin instead of correcting this condition merely tends to exaggerate it giving rise to a vicious circle. That is the more the blood is concentrated the more the insulin acts and the more the blood concentrates.

## CONCLUSION

In postoperative acidosis and dehydrated conditions glucose and water are needed. Insulin is not only not needed but its use is definitely contra indicated.

## BIBLIOGRAPHY

- ANDERS I M Th u of in ul n i glu e  
p e ent n f urg l h ck C l f a & W t  
M 927 50-6
- ANERFW I DML D 5 g m ta l l m n d h y d r  
t Ar h Int Med 19 6 136-14
- 3 ANI FW I DML D a l Sch F LL KARL Eff t  
f r y g d g e e l h y d t o n n u g r m e t a b o l  
Ar h l t M l 19 7 63 646
- 4 BANTY T C D l t e d l l Ca d M  
A J 1926 6 2 33 F h S e L k  
S l l k S a m m n k l 189-0  
B r r f v l l d e o k e D e p o t o p t  
A l o n d h r B h n d l A h f k l h  
927 13 23 37
- 5 BLI D l K C m b n d of l n d g l  
g r y West V t n i M J 9 6 4  
CL RA O I n u l n t a t m t h c c u y n d p e t t  
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6 f t i t s M c l i d f J R o b f f u l  
d g l y e l y A m J l h y l 19 3 l 46 47
- 7 I C L D I R O l L t e n d a l e t I d c l g v 9  
x 33  
I L T W I l d C l k o D t c h m l  
W h l 927 l 0 4  
I I R R D d o k e J A m M A 9 4  
l 1 9 6-998  
I l l r D n d M A S S I N I I n l g l u t t  
m e t o f u g c a l h c k a d n o n l b t a d  
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- 8 I l l r D n l S F L L F Th u l n t r e a t r t r  
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- 9 M A C L E A H I n u l u g r y P r o c R o y S o  
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- 10 M c l p o d J J l n d C A M K O F F I L I f f e c t f  
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- 11 M A C L O D J J K n d M R A l r z F l t h  
e a h s n d e p n c t e d n m a l t e t d t h  
u l 7 A A m Ph n 926 l 147 6
- 12 O R I T R V I u l l g v d u t h e Z t r f  
l 9 c x v 57 68
- 13 R A N D L H F I n u l l d t e t h e r a p f  
M h u g n M S o 19 97  
14 R A N I R M J B l C h m 9 3 l 1 483
- 15 T H A L I M R W I l n t r t m t f p o t o p t  
( d b e t ) d J A m M A s 9 3  
l 333 385  
I l m l t p a t t t m e t t h g l e a n d m  
l W o c M J 92 560 9 3
- 16 T U A C M N I l g l c e s g l b l k  
J I n l p r e c l i d M A 9 83 2 6

HÆMOLYTIC ANÆMIA IN PREGNANCY<sup>1</sup>

BY WILLIAM ALLAN, M.D. CHARLOTTE, NORTH CAROLINA

**T**HL pernicious anæmia of pregnancy is an acute hæmolytic anæmia which occurs in women under 35 years of age is due to pregnancy progresses steadily without remissions to death or recovery and is curable by blood transfusion. Thus it differs from Addisonian pernicious anæmia which is essentially a chronic disease of unknown etiology occurring after 35 years of age predominantly in men is not curable by blood transfusion and runs a course characterized by remissions.

About 3 per cent of the cases listed as pernicious anæmia (4) occur during or shortly after pregnancy. In the British Isles this anæmia is seen once in every 1000 to 10000 pregnancies. Hoskins (11) considers the condition common in Northern India and McSwinnery (14) finds an incidence of 1.69 per cent in one of the Calcutta hospitals. McSwinnery's cases were chiefly among Hindus while in Bombay Balfour (2) found this anæmia proportionally much more common among Mohammedans a fact which she attributes to their confined life during pregnancy. There are no figures for the United States but from the reports of Smith (24) of Rocky Mount and my own observations in Charlotte I suspect that this condition is not very infrequent in North Carolina.

Balfour says that in Bombay this anæmia is more prevalent during the last half of the year because of the great number of diarrhoeal cases at that time.

Of 500 cases taken from the literature (7, 8, 11, 12, 14, 15, 16, 17, 22, 23, 24) 75 per cent occurred in patients under 30 years of age and 9 per cent occurred in primipare.

The appearance of the patient is that seen in any severe anæmia. There is a lemon tint to the skin in half the cases (22). Puffiness of the face and feet is common. The symptoms are those of any severe anæmia: weakness, vertigo, dyspnoea, palpitation, poor vision and especially sore mouth, diarrhoea and vomiting. There is generally fever (Schmidt reports fever in 97 per cent) starting 1 day or

two after delivery and frequently leading to the mistaken diagnosis of sepsis.

The physical findings include blanched mucous membranes, retinal hemorrhages (1, 11, 21, 22), sore tongue, a great variety of heart murmurs, enlargement of the spleen (Balfour 18 per cent, Larrabee 70 per cent, Schmidt 30 per cent, McSwinnery 16 per cent) and less often enlargement of the liver (Balfour 8 per cent, Larrabee 16 per cent) with slight œdema often limited to the face. Probably because of the short duration of the anæmia, cord lesions have not been demonstrated though pain and paræsthesias are common (21, 22). The blood pressure may be low as in anæmia generally or it may rise as in other toxemias of pregnancy (21).

About one half of the cases show a variable amount of albumin in the urine with urobilinogen and occasional casts. Hoskins has reported bile in the urine. There are no other urinary findings of interest.

The gastric juice may show diminished or absent free hydrochloric acid (21, 2) but achlorhydria is not the invariable rule here as in chronic pernicious anæmia.

The blood picture is very much like that of ordinary pernicious anæmia with greatly diminished hæmoglobin and red cells, a high color index and the usual variation in size, shape and staining reactions of the red cells. The diameter of the red cells is decreased (8, 15, 2) rather than increased. Nucleated red cells are present but in the majority of cases these are normoblasts. The platelets have been reported as diminished (1, 8) or normal (15). The bile pigments in the blood are increased. Minor reports increased fragility of the red blood cells with 16 per cent reticulocytes in one case before delivery, both of these factors promptly returning to normal after delivery. There is some discrepancy of opinion about the number of white cells. Aubertin says that there are generally more than 15,000 and in 55 cases he has never seen less than 4,000. Schmidt reports 10,000 or more leucocyte in 68 per cent of cases and

less than 6000 in 8 per cent Rowland says there may be a leucocytosis regularly during the rapid hemopoiesis of convalescence as well as in the early so called physiologic stage of the anemia and cites one of Oler's (19) cases in which there were 45000 leucocytes other observers report leucopenia frequently a low as 2500 (1-4)

A tabulation of some of the cases recently reported (1-3, 6, 8, 11, 12, 14, 15, 16, 19, 21, 23, 24) show an average hemoglobin of 50 per cent in 101 cases and an average red cell count of 1,464,000 in 137 cases giving an average color index slightly above 1 in 5 cases the leucocytes averaged 6,466 with polynuclear 55 per cent lymphocytes 63 per cent large mononuclear 4 per cent and eosinophile 13 per cent

The anemia comes on insidiously during the later months of pregnancy and is generally discovered shortly after delivery. Miscarriage or premature labor is the rule. The loss of blood during labor is less than normal. The child fortunately does not share the mother's anemia (1-15). The course may be rapidly downward to death within a week or recovery may ensue after several months of illness.

After the uterus is empty blood transfusion stops hemolysis and leads to prompt recovery in 90 per cent of the cases (3, 6, 10, 11, 13, 16, 17, 20, 21, 24). I can find no record of recovery before delivery and whether recovery is unknown except after the uterus has been emptied. Rowland recommends that this measure be carried out promptly. Without transfusion 84 out of 111 patients or 40 per cent have died (9, 11, 14, 15, 16, 19, 21, 23, 24, 25). Gallupe and O'Hara place the maternal mortality at 50 per cent. Larrabee at 75 per cent and Delmen (5) at 87 per cent. McSwinney had a mortality of 5 per cent in 43 hospital patients in California and Balfour reports a mortality of 42 per cent among 150 patients seen by her in Bombay.

The changes found at autopsy as described by Schmidt and by Balfour are similar to those found in chronic pernicious anemia. That this anemia is due in some way to pregnancy seems obvious but speculation as

to how pregnancy produces it does not seem profitable in the present state of our knowledge. As emphasized 10 years ago by Schmidt blood transfusion is a life saving measure but this fact is not as well known as it might be.

As was to be expected following the work of Minot and Murphy the feeding of liver has been recommended in mild types of hemolytic anemia by Murdock (16) but in a large percentage of instances the process is too acute to warrant the institution of a dietary therapy. It may be that liver feeding after transfusion will be beneficial and it will be very interesting to see what liver feeding during pregnancy may accomplish in preventing this anemia. However when one of these cases is recognized prompt transfusion is certainly the safest therapeutic measure.

**CASE 1** In 1910 I saw with Dr F D Austin a young primipara 3 months after normal delivery at term. She had developed diarrhea a month or so before labor and this had continued during the 3 months since labor. Examination of the blood showed hemoglobin 35 per cent red count 940,000 color index 1.8 white count 6000 with a normal differential count. There were 420 nucleated red cells per cubic millimeter. The patient recovered completely on symptomatic treatment.

**CASE 2** In April 1914 Dr J A Anderson of Gastonia referred to me a young married woman 19 years old with a rather well marked secondary anemia. The previous January she had had a miscarriage at the end of the 5th month and a week later had edema a greenish yellow color and went into collapse but gradually improved under symptomatic treatment. The next year she went through normal pregnancy and labor without anemia.

**CASE 3** In July 1925 I saw with Dr Vann Matthews a woman of 30 years 5 weeks after her third pregnancy had terminated at term by normal labor. She had fever beginning the day after labor and at the end of 3 weeks had a greenish look. A week before I saw her Dr Matthews had given her a transfusion. The hemoglobin was then 35 per cent and there were 1,108,000 red cells and 2,400 white cells. During the week after her transfusion she had suffered from an infected arm and violent herpes labialis so that when I saw her the hemoglobin was 25 per cent red cell 832,000 color index 5 white count 2,700 with polynuclears 55 per cent lymphocytes 44 per cent and eosinophiles 1 per cent. The red cells showed considerable variation in size shape and staining reaction and a few normoblasts were seen. After another transfusion this patient made an uneventful recovery and is well today.

CASE 4 In March 1926 Dr James Davis of Wadesboro brought me a young married woman of 24 years Six weeks before she had had normal labor following a 9 months pregnancy During the puerperium she had fever daily and had become steadily paler and weaker but had refused to go to the hospital until it became evident that she would die She was seen at midnight Temperature was 101 degrees pulse 125 respiration 46 with marked air hunger The patient was comatose and restless Her skin was very pale with a strong lemon tint There was some œdema of the face but none elsewhere The examination of the blood showed hæmoglobin 25 per cent red count 742 000 color index 1.8 white count 6 600 with polynuclears 66 per cent lymphocytes 33 per cent basophiles 1 per cent the red cells showed marked variation in size shape and staining reaction and many nucleated reds were present including typical megaloblasts The urine showed only a trace of albumin but was positive for urobilinogen The patient was at once given a citrate transfusion by Dr Barret and a second one the next day At the end of 10 days she was sent home with a hæmoglobin of 50 per cent and a red count of 3 472 000

On August 31 1917 Dr Barret and I were called to Wadesboro to see this patient again Her third pregnancy had ended at term with a normal labor 19 days before A week before delivery the hæmoglobin had been 50 per cent and the red count 2 500 000 The day before delivery her blood pressure reached 160 Urine showed albumin and casts in abundance For 2 weeks after delivery she was apparently holding her own but then developed an abscessed breast The hæmoglobin dropped to 30 per cent and the red cells to 1 29 000 The color index was 1.1 She had had fever ever since delivery When the patient was seen on August 31 the hæmoglobin was 10 per cent and the red count was 960 000 with great variation of size shape and staining reaction of the red cells Many normoblasts were seen but no megaloblasts The white count was only 2 500 with 70 per cent polynuclears She was given 800 cubic centimeters of blood by direct transfusion by Dr Barret On September 28 Dr Davis reported that the hæmoglobin was 65 per cent the red blood cell count 2 800 000 and the white cell count 5 000 The patient was steadily improving

There have been some reports of the recurrence of this anæmia in subsequent pregnancies Murdock thinks there is a strong probability of recurrence and thought it likely that his second patient had suffered with hæmolytic anæmia following labor 6 years previously In the second case reported by Gullupe and O'Hara there was a history of anæmia in each of the 3 preceding pregnancies severe enough in the next preceding

pregnancy to have kept the patient in bed for a few weeks

Hahr (9) reports the case of a woman 18 years who presented a picture of pernicious anæmia in 1908 weeks after delivery In the spring of 1913 she returned 3 months pregnant and again presented a picture of pernicious anæmia She died the next year with Hodgkin's disease

Oettingen (17) reports the case of a woman with hæmolytic anæmia following her third pregnancy who had had severe anæmia of some sort with her first pregnancies To prevent recurrence she was sterilized Keist (10) reports the case of a woman who had been chlorotic from her fifteenth to nineteenth years She was anæmic during the first and second pregnancies and after her third pregnancy presented a picture of pernicious anæmia She was sterilized to prevent further recurrence

Vermelin and Vigneul (25) report the case of a woman whose first pregnancy was normal in the fifth month of her second pregnancy she showed pernicious anæmia and miscarried during the eighth month with fetus stillborn She was clinically normal the next year but aborted during the second month of her third pregnancy Three months later she again became pregnant and in the seventh month of this fourth pregnancy showed the picture of pernicious anæmia Premature delivery was induced The patient died 2 days later

McSwinnay saw a woman during her sixth pregnancy with hæmoglobin 40 per cent white blood count 3 000 000 color index .66 A year later at the time of her seventh labor the hæmoglobin was 35 per cent with red count 2 000 000 color index .88 The patient grew rapidly worse and died 5 days after labor

These reports on recurrence show that the patient seen in two succeeding pregnancies by Hahr died a year later of Hodgkin's disease The patient seen in two succeeding pregnancies by McSwinnay died within a week after the second labor The others all saw women who gave a clinical history of anæmia with previous pregnancies The fourth case reported was seen in two succeeding preg-



nancies each time with less than 1 000 000 red cells and in each incidence recovered promptly after transfusion

Because of the rarity of recurrence and the promptness with which this anemia can be controlled by transfusion sterilization of these patient to prevent possible recurrence seems to me entirely unwarranted

#### SUMMARY

The hemolytic anemia of pregnancy is an acute condition and should no longer be classified a pernicious anemia

It responds promptly to blood transfusion after the uterus has been emptied

The danger of recurrence need not be a contra indication to pregnancy and calls for nothing more radical than proper supervision of the patient during subsequent pregnancies

#### BIBLIOGRAPHY

A T C I m d o 4 3  
B D T M I I d n M C 9 1 491

- 3 BONTA M B Rep W e k l y Staff M e t u n g M d  
C h i 1 1 9 2 6 1 5 3
- 4 CABOT R C O l Mode n M e d i e 9 7 3
- 5 DEVERA Thes de d c t I 1 9 3 0 t e d b y  
S h m i l t
- 6 DREXEL T M e l K l n 1 9 6 1 9 6
- 7 J A L F Y P A m J O l t 1 9 8 1 1 6
- 8 GALLUP H O a d O H A R A D B s t o M & S J  
9 2 4 c 6
- 9 HALLIR O M d K l 1 9 5 4 9 8
- 10 H E B K / t r a l l f C y n e k 9 2 3 v l 8 8
- 11 H O K I T J I n t 9 2 7 x 4 3 3
- 12 I A R R A I R C A m J M S c 9 2 5 c l 3 7
- 13 I A S L A L a n l T z a c A T P e m d 9  
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- 14 M C S W A F V S A I I M C a 1 9 1 4 8
- 15 M I T J C M e l C l n A m o 7 3 3
- 16 M I C K F I A I t M d 9 2 7 1 3 3
- 17 O T T I N E N A / n t r l l f C y n k 9 2 4 1
- 18 O F L D H M t l r f C b t h u C y n e k  
1 9 1 1
- 19 O L F W B t M f 1 9 9 1  
R F T A / e t l l f C n a k 9 6 1 4 9 6  
R o u l t A C J A m M A 9 4 1 3 7  
S c h m i d t H B S g C y n e c & O b t 9 8 1 1
- 20 S C I M R C H M a t h r f G b u t h u  
C y n k 1 9 4 1 3 1
- 21 S I T C F S k C y n & O b t 9 1 3
- 22 V E R M L I d A l c E L L Q o t d b y R e t

# CLINICAL SURGERY

FROM THE BRONCHOSCOPIC CLINIC OF THE ROYAL VICTORIA HOSPITAL

## THE TECHNIQUE OF BRONCHOSCOPIC PNEUMONOGRAPHY WITH LIPIODOL

By DAVID H. BALLOU, M.D., F.A.C.S., MONTREAL, CANADA

SINCE the epoch making introduction of lipiodol in 1921 by Sicard and Forestier (13) in the diagnosis of bronchopulmonary lesions numerous methods have been devised for the injection of lipiodol in the bronchial tree. These methods can be classified into two groups: the direct bronchoscopic (2 and 3) and the indirect intratracheal methods.

Our purpose here is not to discuss the merits, difficulties and dangers of the different intratracheal methods—they all have their place and importance—but rather to emphasize the value of the direct bronchoscopic method for pneumonography (5) for the following reasons:

1. The invaluable aid afforded by direct inspection of the bronchial tree.

2. The possibility of making a bronchoscopic diagnosis, taking uncontaminated cultures for diagnosis and vaccine therapy, removing stenosing granulations (4) and aspirating pus from drowned areas of the lung and thus allowing a more thorough filling of the region of the lung to be investigated.

3. If lipiodol has any therapeutic value then it is most desirable that before it is introduced bronchi and cavities filled with pus and debris should first be cleared as thoroughly as possible in order that this iodized oil can act directly on diseased mucous membrane and its effect be observed at a later date.

4. As our knowledge of the interpretation of lipiodol roentgenograms is still very imperfect and in order to avoid grave diagnostic errors the bronchoscopic method remains essential for the elucidation of roentgenograms and the clinical findings.

### INDICATIONS

Every case for pneumonography must be considered by itself and a decision arrived at by the internist, surgeon, roentgenologist and bronchoscopist before the injection is carried out. As a

general rule, the cases suitable for injection are all forms of chronic bronchopulmonary and pleural suppurations in which a differential diagnosis between bronchiectasis (6), lung abscess, broncho-pleural fistula and empyema is required, also a more accurate differentiation between upper and lower lobe lesions. Lipiodol may be used in cases of acute lung abscess (9) in which other methods have failed to demonstrate a lesion. It is particularly valuable in lesions of the left lung masked by cardiac shadow and pleural thickening.

Lipiodol can be used with comparative safety in carefully selected cases of the surgical type of pulmonary tuberculosis which show definite evidence of resistance. After extrapleural thoracoplasty, lipiodol injections will demonstrate the efficiency of collapse and reveal the cause for persistent signs and symptoms.

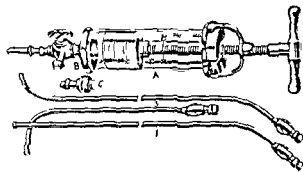
### CONTRA INDICATIONS

In pulmonary tuberculosis (7) of the exudative type, lipiodol not only produces an immediate reaction but may reactivate a quiescent lesion and its persistence in the lung may be attended with ill effects. These observations have been noted both clinically and experimentally. As a general rule, patients with advanced bronchopulmonary diseases and recent hæmoptysis should not be injected.

### DANGERS

Bronchoscopy in the hands of a gentle, careful, thoroughly trained bronchoscopist is practically devoid of danger (1). This has been frequently emphasized by Chevalier Jackson (12) and borne out by the large number of cases examined in his clinic.

To obtain a pneumonogram of real diagnostic value requires proper anaesthesia; it is extremely difficult to carry out a satisfactory bronchoscopic examination and lipiodol injection without any cocaine anaesthesia in patients who cough in



In experimentally produced pulmonary tuberculosis in rabbits Harry Ballou (10) found that the injection of lipiodol in these animals especially when there was an associated acute pneumonic process was immediately followed by grave symptoms and ended fatally. In pulmonary tuberculosis a quiescent lesion may be reactivated by iodized oil. Igler (11) noted the appearance of tubercle bacilli in the sputum for the first time following the injection of iodized oil.

One of the late dangers which will have to be seriously considered is the confusion in diagnosis caused by persistent lipiodol shadows and roentgenologists will have to be on guard in the interpretation of the roentgen ray shadows. The presence of lipiodol in the alveoli may resemble an unresolved pneumonia or an exudative or miliary tuberculosis (12).

#### PREPARATION OF THE PATIENT

Every patient to be injected with lipiodol should have a preliminary physical and roentgen ray examination. All patients whether ambulatory or bedridden are examined early in the morning on an empty stomach to avoid retching and vomiting.

Morphine, atropine and a cathartic for the previous night, cough and atropine checks the profuse salivation. Adults receive a hypodermic injection of 4 grains of morphine and 1/150 or 1/100 grain of atropine one hour before the local anesthetic is applied. Patients with extremely irritable throats who cough incessantly and bring up enormous quantities of pus are given another 3 grains of morphine hypodermically at the beginning of the local anesthetic. Pantopon is substituted for morphine when the latter is not tolerated. In children between the age of 10 and 15 years graded doses of morphine are to be used. The preliminary hypodermic may be dispensed with in some patients who have previously been bronchoscope.

#### ANESTHETIZATION

All injections in my bronchoscopic series of 13 patients ranging between the ages of 11 and 63 years were carried out under local anesthesia (8). It is essential to anesthetize thoroughly the pharynx, hypopharynx and larynx. For this purpose the following mixture is used: 10 per cent solution of cocaine hydrochloride 1 part 1000 solution of adrenalin chloride 2 parts.

In some patients it is of advantage to inject into the trachea with a laryngeal syringe one half of 1 cubic centimeter of a mixture of equal

parts of this drug used after a preliminary hypodermic injection of morphine and atropine is of great value in effectively allaying irritation, which temporarily. Otherwise in imperfectly prepared patients iodized oil causes rather the effect of the disease but it is expelled by the active cough reflexes.

But the actual vital danger and the powerful toxic action of cocaine must ever be kept uppermost in mind. It must be used very cautiously. Unfortunately until now we have not found any anesthetic which by local application has the value and effect of cocaine.

Although at least 50 per cent of the patients swallow some lipiodol as shown by the roentgen ray, no signs of iodism have been found in any of my patients. A patient of Dr. Archibald with an *idi syncrasis to iodine* who developed toxic symptoms in two occasions when iodine was applied to the chest wall and on another when a line ointment was painted on the skin showed no ill effects when lipiodol was injected subcutaneously and when at a later date it was given by mouth. This patient was subsequently injected bronchoscopically with 17 cubic centimeters of lipiodol without showing any signs of iodism.

Lipiodol may be injected with safety in chronic pulmonary suppuration. It is extremely dangerous however to inject lipiodol or any other foreign liquid in the lungs when there is an associated acute respiratory infection or an acute exacerbation of the chronic suppurative process. In these cases the ill effects produced by lipiodol were the result of an aggravation of the underlying condition or a direct extension of the lesion.

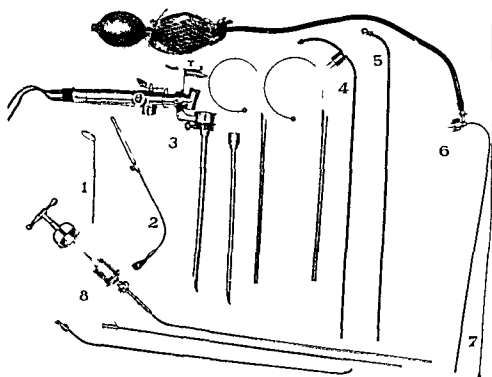


FIG. 2. Instruments required for bronchoscopic pneumonography. 1 Laryngeal mirror, 2 camel hair brush for cocaineization, 3 Kähler Leiter bronchoscope with No. 10 and No. 8 tube for adults and children, 4 Clerf's glass specimen collector, 5 Aspirating tube to be attached to portable aspirator, 6 Cocaine and eucalypti spray if required, 7 Applicator, 8 Ballon lipiodol injectant syringe with tube attached.

parts of 5 per cent cocaine with 1:1000 adrenalin chloride solution prior to the passing of the bronchoscope. This weaker cocaine solution is also sprayed into the trachea and bronchi after the bronchoscope is passed; the spraying is done by a nurse or assistant. Topical applications of this mixture to the carina and bronchi are safer than spraying and therefore preferable.

#### INSTRUMENTS

The following instruments are required: (1) For the preliminary cocaineization a laryngeal mirror and a laryngeal applicator or camel's hair brush. (2) For the bronchoscopic examination a bronchoscope—Jackson Kähler Leiter or Bruning, a portable aspirator with aspirating tubes, sponge carriers for gauze sponges, a Clerf's glass specimen collector, and a cocaine spray. (3) For the pneumonography, Ballon's lipiodol syringe with tubes or any other suitable syringe.

Any standard bronchoscope may be used for pneumonography, depending largely on the experience of the examiner with a certain instrument. The author has used for this purpose the Kähler Leiter bronchoscope. Two tubes are required, No. 8.5 for children and No. 10 for adults.

#### DOSE

The quantity of lipiodol to be injected varies from 10 to 40 cubic centimeters and is determined by the age, size, condition of the patient, the nature and extent of the lesion, and the normal lung area requiring to be filled for contrast. In order to map out both lungs, 25 to 30 cubic centimeters is usually sufficient.

#### TECHNIQUE

After the preliminary cocaineization, a roentgenogram is taken; the patient is then placed on the roentgen ray examining table in the dorsal decubitus position. The usual aseptic precautions are observed. The head is slightly elevated and extended and rests on the table; the eyes and face remain uncovered; the teeth are protected by a layer of gauze; the bronchoscope is armed over an alcohol flame, is held in the right hand and supported by the fingers of the left hand; the latter also protects the upper teeth in lip-then gently passed between the teeth and the cords into the trachea. A culture is taken with a Clerf's glass specimen collector; the local anesthetic is then sprayed or applied to the trachea; the main carina and bronchi are obtained; cough, pus and secretion are aspirated if



Fig 3. Patient in dorsal decubitus position. The patient is lying on their back, and the medical professional is performing a procedure on their chest area.

trachea and main bronchi in order to permit of a better filling. A careful examination is now made of the area of the lung to be injected. Granulations if present are removed for biopsy and lipiodol is then injected with any suitable syringe through the bronchoscope into the different bronchi under direct vision the nurse or assistant slowly turning the piston of the syringe. While the patient is being injected he can be



Fig 4. Patient in dorsal decubitus position. The patient is lying on their back, and the medical professional is performing a procedure on their chest area.



Fig 5. Patient in dorsal decubitus position. The patient is lying on their back, and the medical professional is performing a procedure on their chest area.

turned either to the right or to the left side and so both halves of the lung are filled as with the patient in the dorsal decubitus the posterior part of the lung is chiefly outlined. Fluoroscopic observations can also be made at this time this often affords an excellent means of localizing the lesion. As soon as the injection is completed the bronchoscope is withdrawn the patient being cautioned not to cough and roentgenograms taken in the supine prone semilateral lateral and sitting positions as the case may indicate. When the patient has been thoroughly anesthetized a series of roentgenograms can be taken in one instance a dozen were taken at interval of 4 minutes and studies made of the effect of posture respiratory movements and the cough reflex. Anteroposterior views are taken with the head raised 45 degrees in order to permit the better filling of the lower lobes. The head is later lowered 45 degrees in order to observe whether the upper lobes would be better filled by change of posture. Stereoscopic pictures should always be taken immediately after the injection has been completed with the patient in the dorsal decubitus or sitting position.

The advantage of the author's bronchoscopic method is that the entire technique is carried out by the operator with the sole assistance of a nurse trained in bronchoscopy who hands instruments suction tube sponges and turns the piston of the lipiodol syringe.

In pulmonary tuberculosis only the diseased area is to be injected and the quantity limited to 10 to 15 cubic centimeters. In cases of pulmonary tuberculosis where the bronchoscopic examination

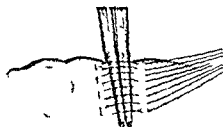
tion may be contra indicated the lipiodol can be injected by the transglottic method

The after care is confined to symptomatic treatment

## BIBLIOGRAPHY

- 1 ARCHIBALD EDWARD and BROWN A LINCOLN Dangers of introducing iodized oil into the tracheobronchial system *J Am M Ass* 1927 lxxviii 1310-1315
- 2 BALLON DAVID H The injection of lipiodol as an aid in the X ray diagnosis of bronchopulmonary lesions including tuberculosis *Canad M Ass J* 1925 xi 995-999  
Idem Lipiodol in the diagnosis of bronchopulmonary lesions by the bronchoscopic method report of fifty cases *Arch Otol* 1926 iii 403-42
- 4 Idem Primary carcinoma of the bronchus with abscess of the lung diagnosed bronchoscopically and injected with lipiodol *N York M J & Rec* 1927 cxxv 2 5-28
- 5 BALLON DAVID H and BALLON HARRY C Pneumono-graphy with iodized oil 40 per cent by the bronchoscopic method *Arch Surg* 1927 xiv 184-20
- 6 Idem The diagnosis of bronchiectasis Further studies on the value of lipiodol by the bronchoscopic method *Acta Oto Laryngol* 1927 xi
- 7 Idem The effect of injection of lipiodol and the rate of its disappearance in the normal and diseased lungs *Canad M Ass J* 1927 xvii 410-416
- 8 Idem Einige Beobachtungen ueber den Wert des Lipiodols als Hilfsmittel in der Diagnose und als Wegweiser in der Behandlung von Krankheiten des Bronchopulmonaltraktes *Monatschr f Ohrenh u Laryngo Rhinol* 1927 lxi 1197-1234
- 9 BALLON HARRY C The value of lipiodol in the diagnosis and treatment of abscess of the lung *Surg Gynec & Obst* 1927 lxi 1-10
- 10 Idem Lipiodol bei Lungentuberkulose experimentelle klinische und pathologische Studie *Frankfurt Ztschr f Path* 1928 xxxv 20-21
- 11 IGLAUER SAMUEL The use of iodized oil in the diagnosis of pulmonary lesions *Surg Gynec. & Obst* 1927 xlv 82-87
- 12 JACKSON CHEVALIER Bronchoscopy and angioscopy a brief consideration of technique *Surg Gynec & Obst* 1927 xlv 19-24
- 13 SICARD J A and FORESTIER G Method of radiographic exploration on radioraque par l'huile iodée *Bull et mém Soc méd d hôp de Pa* 1922 xlv 473





Fi



Fi 3



Fi 4

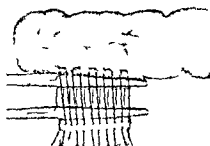


Fig 5



Fi 6



Fig

Fig 2 The diseased portion of bowel has been removed. The clamps are approximating the ends which have been cut and sealed with the cautery. Mattress sutures of silk have been inserted in practice much nearer to the clamps than indicated in the illustration.

Fig 3 Clamps have been removed showing the bowel ends crushed and sealed.

Fig 4 First row of sutures tied, the ends turned in, and one of the second row of sutures introduced. These sutures for the purpose of illustration are drawn farther apart than they are actually inserted.

Fig 5 End to side anastomosis. The lateral wall of the colon has been clamped and the portion which bulges through it has been burned away. The ileum is brought into contact with it and mattress sutures are being introduced.

Fig 6 The clamps have been removed, bringing into view the crushed side of the cæcum and the end of the ileum.

Fig 7 Mattress sutures tied and one of the Lembert row being introduced. This completes the anastomosis. (The ileum is drawn much too large.)



EPISPADIAS IN FEMALES AND ITS SURGICAL TREATMENT<sup>1</sup>

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A. P. I. T. I. I. I. m. f. M. d. U. y. f. Roch.

It is commonly stated in textbooks and elsewhere that in the female epispadias is a very rare condition and curiosity for the surgeon which he must meet by genial improvisation if he be capable thereof. Study of the literature however discloses that quite a large number of cases has been reported for the most part singly and that while surgical improvisation has been depended upon in the treatment of most of them it is now possible as a result of all this experience to formulate definite and well founded surgical principles which shall govern the operations performed for this condition.

The analogy between epispadias in the female and epispadia in the male was first recognized by Morpain in 1855 (48). He observed a case in a female 61 years of age described it accurately and published an excellent drawing of it. Similar cases had previously been observed but no one had seriously attempted an explanation of the condition or given it a name. This bit of keen observation and accurate reasoning by Morpain deserves to be noted. His conclusions however were doubtful and even opposed by many. Most surgical writers of his day and for some time thereafter denied the existence of epispadias in the female. Among these was Guyon but later on when he had the opportunity of observing a case he admitted his error. This case of Guyon was reported by Nunez in 1881 (5). He also discussed most of the cases which had been observed up to that time. The classic monograph is that of Durand in 1895 (17). Durand had no case of his own and his search of the literature was incomplete since he referred to only 9 cases. However from these cases he constructed a theory of the embryological origin and a classification of the case into three groups. This classification has been generally accepted up to the present time. In 1896 Ballantyne (7) published another monograph including a study of 33 cases which he had found in a very thorough search of the literature. He follows the classification of Durand and expresses rather pessimistic views concerning the advisability of surgical treatment. Rasch in 1891 (6) wrote a splendid summary of the subject up to that date. He also follows Durand in giving much more thoroughness in the etiological portion. His conclusion however is somewhat indefinite and leaves the operator at a loss. Other excellent articles

were published by Nové Jossier and Cotte (51) and Burckhardt (11).

Ideas which have been held concerning the embryological origin of epispadias in the male are well known to most urologists and the explanation of the condition in the female is undoubtedly the same. Numerous theories have been advanced and discarded. Among them may be mentioned that which holds that epispadias hypoplasia exstrophy etc. are due to rupture of the lower urinary tract following temporary occlusion of the urethra (10) that an inflammatory or some other pathological lesion of the lower abdominal wall and cloacal tubercle are responsible that a rotation of the penis causes the urethra to lie above the corpora cavernosa (29) that there is a retardation in the fusion of the cavernous bodies permitting the urethra to pass upward between them and that epispadias is due to a retardation in the development of the cloacal tubercle (78).

At present our views are stated by Johnson (33) are based upon a purely embryological defect and the same explanation is given for both exstrophy of the bladder and epispadias the difference being merely one of degree. There is a cephalad displacement of the cloacal membrane in an early stage of development before the cloacal tubercle has made its appearance. The cloacal tubercle developing later rises below the cloacal membrane so that when the membrane is resorbed the urogenital sinus opens on the dorsum of the phallus rather than on the ventrum. If the displacement of the cloacal membrane extends on to the primitive abdominal wall the result will be exstrophy of the bladder if the displacement is of lesser degree epispadias alone results. According to this theory one should find cases showing all degrees of the deformity from complete exstrophy of the bladder on the one hand to a slight upward displacement of the urethral orifice on the other. These gradations do exist in the female as in the male and lend support to this hypothesis.

## MORPHOLOGY

The majority of cases however correspond to quite a definite type and a short description of this type may be given at this point. In the female the two halves of the corpora cavernosa of the cloacal tubercle do not unite beneath the di-

placed urethra as they do in the male at any rate no such case has been found described in the literature unless it be that of Coustou (13) who simply states that the urethra opened above the clitoris. Instead the two halves of the clitoris which may be markedly underdeveloped remain separated by a considerable distance amounting to several centimeters in adult patients. Along with this separation the anterior portions of the labia minora and labia majora also fail to unite so that a depressed area is left over the site usually occupied by the mons veneris. This depressed area is covered by a smooth glabrous hairless skin beneath which there may be a moderate amount of subcutaneous tissue and fat or the skin may be very closely applied to the anterior and inferior surfaces of the symphysis pubis. The labia minora are usually ill developed and terminate anteriorly at the corresponding half of the bifid clitoris where there may be a rudiment of the preputial fold. These external appearances are most characteristic. On separating the labia however one sees the urethra which may vary considerably in appearance. It may open between the two halves of the clitoris or some distance above them even anterior to the symphysis pubis or it may be represented by a wide funnel shaped opening sometimes large enough to fill the entire space between the two halves of the clitoris and the symphysis.

The urethra is usually increased in diameter but this increase may vary between wide limits. On probing the urethra with instrument or finger one may find the internal sphincter intact in which case there is no incontinence the sphincter may be present but incompetent or there may be no sign whatever of it in which case it is usually possible to insert the finger directly into the bladder without resistance. Unless the internal sphincter be present and competent there is incontinence of urine. In a number of cases the enlargement of the urethra has been so pronounced that there is a herniation of the posterior wall of the bladder through the urethra either continually or upon coughing straining or merely standing erect. The bladder capacity is usually reduced as a result of habitual incontinence but the bladder is usually well formed and capable of dilating to its normal size. The symphysis pubis is usually closed. Early writers laid much stress on the state of the symphysis since they felt that if it were closed there could be no question of bladder exstrophy while if it were open the condition present ought probably to be explained as a mild grade of exstrophy. It now appears that this distinction is of minor im-

portance. A study of Table I will show that in many cases the most extreme deformity of the urethra and aplasia of the sphincteric apparatus may occur in individuals without symphyseal defect while in the case of Sexton (70) a moderate degree of deformity with well developed sphincter and excellent urinary control was associated with a widely separated symphysis. This point is also illustrated by cases known as superior fissure of the bladder which might be described as an exstrophy of the bladder which is necessarily in complete owing to the presence of the symphysis pubis. The opening therefore is confined to the abdominal wall above the symphysis. In the same way a tendency to deformity of the type of epispadias in the urethra and lower part of the bladder may be influenced by the presence or absence of a closed symphysis but it is obvious that it is not absolutely dependent thereon. The vagina and internal genitalia are usually normal though in Nove-Josserand's case there was a double vagina. The hymen is usually circular. The rectal sphincter is usually normal. Although in some cases a prolapse has been noted in many of these cases surgical treatment of the deformity by doing away with the pain and straining consequent upon irritation of the parts by decomposed urine has caused the prolapse to disappear.

#### INCONTINENCE

Incontinence of urine is the rule and is usually complete or nearly so. The principal exception to this rule is in those cases in which the deformity is of the first degree—the vestibular epispadias of Durand. If the internal sphincter is unaffected and normal urinary control is present. In a few cases control is almost but not quite normal there being a slight frequency slight urgency perhaps even slight leakage on unusual straining or exercise. The case of Sexton represents this. With those suffering with a greater degree of incontinence it is particularly to be noted that some of them have been able to control the urine to a certain extent while lying in bed with complete incontinence while sitting standing or walking. In other cases incontinence is complete in the lying position while if the patient sits or stands the urine may be retained for a short time. In a considerable proportion of these latter cases it has been noted that there is herniation or prolapse of the posterior bladder wall while the patient is standing. The author feels that the first group of patients represents those in whom a rudiment of sphincter is present which is able to withhold the urine when the intra-abdominal pressure is reduced as much as possible but not

TABLE I

A h	A	l i	f	l m	R i
Am d C 76		l d	l	l	—
P t f L 77 (		N l t m	ml	—	—
Id m		E b h l	ml	—	—
P nch 84 (	d	F m m gum t bo h f d h b d f h g y h i f l l l	p l	—	l l f t l l p o t d
5 H g 8 (	Al	U h d t l p f f m h b u d	N	—	—
6 Co 1 89 (61)	N 8	O f f t l d d j m p h l m b l h h l m d l	N b h	—	—
7 T 1 95 ( )	3	A l g p o u e b b g u p b w b l b m m l w l l d d	C m l h h l l	—	C m l l f p l k t f q u e r y m
8 H 1 855 ( )	7	T y p l p t p f h b h w p t b l y	C m l	—	—
9 M P 855 (48)	6	L a g h r l p h l d	N	—	—
Roe 86 O d by (66)	9	I l d d d m f b o d y m b y l d	C m l	—	C g d h h l k h a n p g h
Moell 86 (6)	3 d	y m p h p d d m u n l w a l l A p y	N d	—	—
S w y 866 ( )	3	T y t l b l d i h f g h g u h f R e c t a l p l p w b	P t w l h	—	—
Al un ech 96 (5)	5	H l d d m f h m l b b d	C m p l	—	—
F k 87 ( )	7	U h d m f m r u	P a l l k	—	—
Emm 87-73 (3)	3	C l t l y m p h d f f p o f h	Le h f h r p o s d	—	N p o
S vas 873 7 (68)	7	N d 905 f l f m l p d a s	?	?	?
Co 8 ( )		l h r d b o l	N	—	—
P uegh l l 87 ( )	3	L h h l f b l d l l f d	P l c o l	—	N m m

9	M k 88 (47)		3	Bl dd phys	dim t f g l i b n t	th f t typ l	C m p l t	( ) L plast 3 4) U d d p l gth d ymph t (6 7 8) Poo h l g m t p p l e d	C t t 4 h d y d g h b t h g y d t k f w d p p t p t
	F mm l 88 ( )	63	Typ cal	dim t f g l i b n t	th f t typ l	C m p l t	Plast th d p ct d g f l gth m g f b d g f	C t t 4 h d y d g h b t h g y d t k f w d p p t p t	C t t 4 h d y d g h b t h g y d t k f w d p p t p t
	N 88 (5 )	73	L g an bl dd	l t bl dd t f d ymphy cl d	f	Compl t	R d l i z t f th	N mp m t	N mp m t
	Camp II 883 ( )	3	L g an bl dd	l t bl dd t f d ymphy cl d	f	Compl t	Op t d f d t l ft p b ty f th po t	—	—
3	Gott h lk 883 (7)	yr	Typ l	l t b f d ymphy l d	C m p l t	C m p l t	Tw pe t y pp th et l pla t	C t t 4 h d y d g h b t h g y d t k f w d p p t p t	C t t 4 h d y d g h b t h g y d t k f w d p p t p t
4	N bl Sm th 884 (5)	33	Typ l	bl dd dmt f xpo d l t b f d	C m p l t	C m p l t	R ect f t l l f w d dg t g th	C t t 4 h d y d g h b t h g y d t k f w d p p t p t	C t t 4 h d y d g h b t h g y d t k f w d p p t p t
5	Ad m 885 ( )	yr	E t m	l g t l h w m is d t d d w t	C m p l t	C m p l t	( ) E t l l last cl is ( ) f m b l ymph t m y t l pla t with is f p t f th	Imp d h d l l l l l k g b t t l l l l	Imp d h d l l l l l k g b t t l l l l
6	R m 3 886 (6)	3	Cl t ns	d m d m d d by l d g t bl d l ymphy	C m p l t	C m p l t	N	—	—
7	Poh 886 (3)	83	Typ cal	bl dd dmt f l t p t l b f d ymphy	C m p l t	C m p l t	E t l p l t ly	V y light p m t	V y light p m t
8	Ru h t 887 (64)	6 yr	G t l d g t	f f t d cl t b f d	Partial l k s m m t	C m p l t	E t l p l t ly	L k g t h t d h l f l y g Imp m t q t l y	L k g t h t d h l f l y g Imp m t q t l y
9	G ns 3 889 (4)	43	Typ cal	bl dd dmt f l t t d l t b f d	C m p l t	C m p l t	N y p f t p m t ( ) R f th t f p l k p t (3) T t f th 3 m g t l 45 d g	F t p e u w f l es Alt th d co t f 5 h t k 4 m t d Post p t p o d t t d	F t p e u w f l es Alt th d co t f 5 h t k 4 m t d Post p t p o d t t d
3	V d II 889 (70)	33	Typ l	l k l t b f d t d ymphy l d	C m p l t	C m p l t	U th l f l d p t bl d f m d w th m d f m	C t t 4 h d y d g h b t h g y d t k f w d p p t p t	C t t 4 h d y d g h b t h g y d t k f w d p p t p t
3	R th f d 890 (67)	Ad lt	U thr l t k l t r a t l l y b f d	f t f ymphy	N	N	N	—	—
3	T mm 89 (76)	yr	Typ l	Cl t b f d bl dd dmt f g	C m p l t	C m p l t	P m t p p b f t l l m f th	Sm l l v l f t l m d p p t	Sm l l v l f t l m d p p t
33	A f t 89 (6)	93	Cl t	t bl dd dmt f m p p e l l t k t l l d b t t ymphy	C m p l t	C m p l t	Ext l p l t t t g u l p m d p l l g l w l l f th p p f l l l	C t t 4 h d y d g h b t h g y d t k f w d p p t p t	C t t 4 h d y d g h b t h g y d t k f w d p p t p t
34	F t 89 (3)	3	Cl t	d l b p l t d t k f m m b l c u (3 m) m b l cal h l f t l	N	N	R m l d l f h l d t l	W l l f t p t th l	W l l f t p t th l

TABLE I—(continued)

[illegible]

5	G t h w 9 (8)	3 yr	Typ 1	3 mph	loc d	C mp l t	( ) E t i p l t t ( ) U d r p h y (3) U t h p h y b t g a h d d (4) R u t t h r t g d g r	N mp m t
5	N e j m d d C t t 907 (5)	55	Typ 1	Albo h d d bl	g p	Compl t	U t h p l t d x l t	N mp m t
5	Block 908 (2)	937	Typ 1			P t	E t m f p l t	Mt p p l t t f p t c o t t C t p t
53	P l y t t 908 (6)	43	Typ 1	l t b f l j t h m f l		P r t	T b g h t g t h p t h h b l g d t g t h r v p p p t f p h t Good h l g	N t t l t
54	v M y r s b h 908 (44)	37	Typ 1	bl d d d m t f	l h y	P t	E t d g f t h l g t h c m d b f t h l g t h g x	C h f d t b t t l d
55	H l b r u h 909 (3)	3	Typ 1	bl d d l	d f n g	P r t	P p t t ( ) R t C t t t t t t t t t t t R f d t t t t t t t t t t y l t m p t t t t t t t f t t t t t t t t t t t t	A t f t h p t t t t t t m l t t t t t t t t t t
56	Goebell 9 (5)	3	Ep p d	d t	f t h d	P r t	( ) E t m l p l a c t f h t t t p h t t t t t t t t t 3 l m c t b g h t t w d t l d t h r	U y t t t t t t t t t t p t t t t t t t t t t t t
57	H l s c h m 9 (9)	43	Typ 1	b f d l t t b l d d d m t f n g		P t	W e l f d R s c h p t t t t t p h t t t t t t t t t t t t m t h o d l t	I l
58	S l 9 (7)	337	Typ 1	b f d l t b l d d d m t f n		P t	T m j l t t t t t t t g	Good l t y f t t
59	Id m	737	c m	x c p t d d t d m t f n g d l y		P t	c m p t	( c o o l m f t p t
6	P l k h 9 (55)	53	Typ 1	c a b f d l t t h d m t f n g		C mp l t	B l t l d g h p d t t f t t t t t t t t t t t t	C l t t h h l f 3 4 h k h t f p t t t t t t t
6	W t h m 9 (8)	73	Ep p d	d s c p t g		P	P p t t ( ) f f t t t t t t t t t t t t t f t t p t t t t t t t t t (4) R f t	P f m t t t t t t t t h f f t t a l t t t t
6	S h m h 9 (6)	3	Typ 1	t f d l t s d p l f t		C mp l t	( ) O p t	C t t t t d g d y t h g h t s k f t p t
63	Id m	93	Typ 1	b f d l t t f p g t h l p m		C mp l t	( ) O p t	V d 3 4 t m l l y t y m f t p t t t t t t t



when it is increased by the erect position while in the second group of cases the comparative continence existing while the patient is erect is not due to the presence of any sphincter but to the plugging of the urethral opening by the herniated posterior bladder wall. The observation of Surmay (7) supports this view. He noted in his patient a girl of 14 that the bladder mucosa was prolapsed through the urethral orifice looking like half a cherry and that when a finger was inserted and the plug of mucosa pushed back a gush of urine from the bladder was produced.

The degree of incompetence of the vesical sphincter does not necessarily depend on the degree of the external deformity. In Morpain's case the urethra was very large but continence was present while in a number of other cases there was complete incontinence the urethra being only moderately larger than normal. The incontinence is very often associated with marked inflammation of the skin of the vulva and surrounding parts due to ammoniacal decomposition of the urine with which they are constantly wet. This may be absent in cases in which there is even partial control or in which the patient has exercised unusually great care in keeping clean.

#### ATYPICAL CASES

Interesting sidelights on the nature of this deformity may be obtained from a study of certain atypical cases. Six of the cases here tabulated differ markedly from the usual form. The case of Tipjakow illustrates a variation in which there is lateral asymmetry. Here the urethra was above and to the right of the clitoris and the right labium minus ended anteriorly at the edge of the vesical orifice. The clitoris was described as being single and lying below and to the left of the urethral orifice where its relations with the left labium minus were normal. It seems likely that there was really a bifid clitoris the left half of which was much better developed than the right. In this case there was comparatively good control of urine until after marriage when some incontinence commenced. One wonders whether this may not have been due to abnormal sexual intercourse which might easily occur because of the large urethral orifice.

The case of Testelin is quite unique. Here the external picture was perfectly characteristic of epispadias the description being that the anterior commissure of the vagina was absent there was a gutter over the pubis and a large pouting orifice above the clitoris which was single but attached to only one labium minus recalling the situation in the case of Ipyjakow. Below the

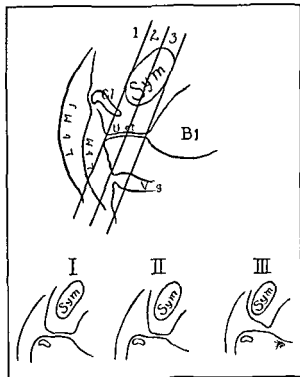
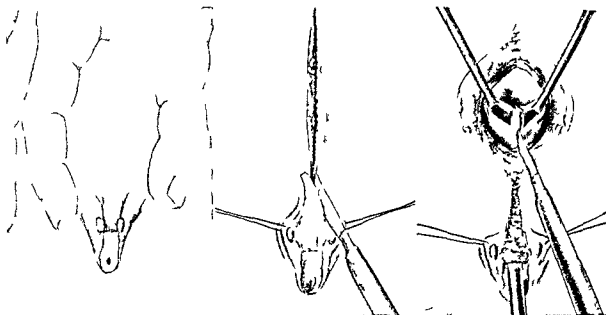


FIG. Diagram showing Durand's classification of epispadias in the female. I The vestibular zone. II The subsymphyseal zone. III The retrosymphyseal zone. The first or vestibular degree of epispadias in which the urethra is practically normal but its relations to the clitoris are altered. 2 The second or subsymphyseal degree of epispadias in which there is a defect in the anterior wall of the urethra for about one-half its length. 3 The third or retrosymphyseal degree of epispadias with defect of the anterior wall of the entire urethra. The sphincter may or may not be involved.

clitoris however was a second orifice which had the appearance of a normal urethra. On passing sounds through these orifices it was found that each communicated with the bladder by a separate channel the lower 6 centimeters long the upper 4 centimeters long. Cauterization of the upper and abnormal orifice with secondary suture finally resulted in its obliteration. The patient then had perfect control of urination through the lower urethra. It is very interesting to speculate on the embryological origin of this strange deformity. One might imagine that the urogenital membrane has suffered an upward displacement of such slight degree that the cloacal tubercle arose in divided form directly to either side of it and as it developed divided in two the lowermost portion of the urethrovesical anlage (the urogenital sinus).

The cases of Penchiennati, Moeller and Furst may be considered together. Unfortunately the description of Penchiennati's case leaves much to be desired. There was a good sized tumor over the pubic bones covered with common tegu-





1

1g 3

1g 4

F C f p l d tl f m l App  
f e r t f m l f th h l f tl  
l t l f m l f th l g  
t Fg 3 l m j f b l f p f d tl

f m l Th l l the h m l da of ab  
m l e t l k  
f g l Th bl d l b b l d n d t e l  
t f m l Th l m l d p f k h a b e

ment which seems to rule out exstrophy. There were two orifices both discharged urine, one in the midline at the upper border of the tumor and another one slightly to one side of the midline at the lower border of the tumor almost at the normal site of the urethra. The symphysis was cleft the vagina normal. The patient died at the age of 4 years and an autopsy was performed but this was so incomplete and reported so badly that one cannot be sure that the internal arrangements were. It seems most likely that the upper orifice represented a patent urachus while the lower one was an epipadiac urethra. Moeller's case is similar except that there was no urachal opening. The symphysis was separated and there

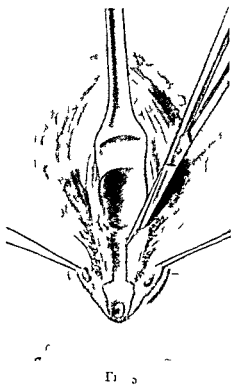
as a hernia of the lower abdominal wall containing the bladder which was however entirely closed on its anterior aspect. Inferior to this hernia was a urethral orifice which had an appearance corresponding exactly with the typical epipadias just described. This case gives strong additional evidence that even where there is a tendency to faulty development of the lower urinary tract a separation of the symphysis does not necessarily mean that there will be exstrophy. In Furst's case it is not definitely stated that the symphysis was open but one feels that it must have been. There was no definite hernia of the

anterior abdominal wall but there was a urachal fistula. A red streak ran from the urachal fistula to the urethra. The labia were separated anteriorly and the clitoris was blind. In spite of all this evidence of faulty development of the lower urinary tract the sphincter was evidently well formed since after closure of the urachal fistula there was no incontinence through the urethra.

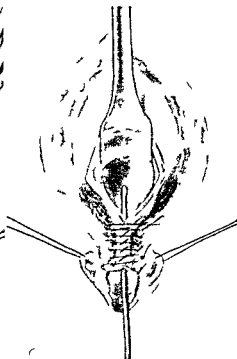
Unfortunately the case of Audion was described so imperfectly that one cannot be certain as to whether or not it represents an atypical malformation in a premature infant. It is stated that there was a large quadrilateral urethral orifice that the clitoris was entirely missing and that there was some separation of the symphysis. It is possible that a more complete description would place this case among the typical cases of epipadias.

#### CLASSIFICATION

In considering such cases as those just described and other cases of atypical and incomplete exstrophy of the bladder it is evident that a nomenclature and delimitation of various groups must be established. Where does epipadias leave off and exstrophy begin? Older writers have attempted to lay down the rule that all cases in which the symphysis is closed must be regarded



Fi 5



Fi 6

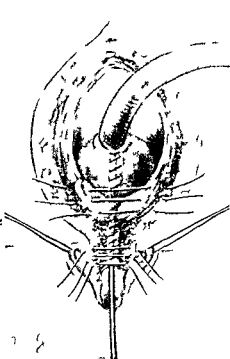


Fig 7

Fig 5 The symphysis has been divided and the entire bladder and urethra have been laid open. Piece of mucosa has been reflected laterally leaving just enough for a normal sized urethra. Note the relation of the new urethra to the ureters and the inter ureteric bar.

Fig 6 The new urethra reconstructed with continuous suture.

Fig 7 The reconstruction is complete. The symphysis is sutured with No. 3 chromic catgut. The halves of the clitoris are drawn together with plain catgut sutures.

as epispadias while if the symphysis is open one is really dealing with mild grades of exstrophy. This dictum is certainly untenable since no one would think of applying the name of exstrophy to the cases of Moeller, Furst or Sexton. To meet this difficulty Durand devised an entirely new term *extroversion* which was applied to those cases in which the urethral defect was extensive the sphincter undeveloped and the bladder mucosa prolapsed. In the interest of simplicity however it would seem advisable not to multiply the terms in use and the name epispadias can be applied perfectly reasonably and understandably to all cases in which there is no open cleft at any point in the anterior wall of the bladder just as in the male. We can then distinguish groups of epispadias. Durand formulated three groups. He considered that there were three zones: first the vestibular zone bounded by a line tangential to the anterior surface of the symphysis and passing through the urethral meatus; second a subsymphyseal zone extending between the line just mentioned and a line drawn between the middle of the symphysis and the midpoint of the urethra; third the retrosymphyseal zone including the tissue between the last named line and a line parallel to it passing

through the vesical orifice. Thus if the deformity is confined to the vestibular zone one has the first degree of epispadias consisting only of a division of the clitoris and an upward displacement of the urethral orifice. With this type there should be no incontinence. In the second degree the deformity extends into the subsymphyseal zone with a defective anterior surface of the urethra here giving rise to a wide funnel shaped orifice but again the sphincteric apparatus should not be involved and urinary control should be present. In the third degree the defect in the anterior wall of the urethra extends back into the retrosymphyseal zone usually involving to a greater or lesser extent the internal sphincter of the bladder with resultant incontinence. When the sphincter is greatly involved in the deformity and the vesical orifice much widened there may be prolapse of the posterior wall of the bladder.

A careful study of the case reports accompanying this article will show that Durand's classification is somewhat too dogmatic since incontinence may be present with slight degrees of urethral deformity while in other cases excellent urinary control may exist along with extreme urethral deformity. The classification however has some usefulness from an anatomical point of view but



t f k l C l t l l m l m l N t t t t t  
 t h l f t l t t l l l l l l t k t h  
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I g l l lt fh t h th t th h l  
 f t l l t l m l ghtly p t d l t t t  
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[illegible]

ceed I should a case come to his attention. The following report is an account of a case seen by the author.

S M H 5 9 F I T 4 f g f t  
 M l ) Tl m pl t f m pl t t  
 f f m t A l f m th g d y t a v m t  
 l f g l b t t l t h l l g t l a l f d  
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 t l k f t l l d t t t f m t  
 t t h g M g w t h t l l l t d f m t  
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 l d Tl h l l t m p l p l f h  
 l l m th g h th th a d f  
 t l m t f h l l t d d th  
 l f l t N i t l d b j e f m d  
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 t l h h t l p p e t l y t p l f  
 l p d l l h y m l r d p p t l  
 m l t t m p p i m l Tl l p  
 t h t m f Th p e g t th b l d i  
 l l l t t h r w p l p U d p p i  
 t l y Th h l e f the l t m l l  
 l l l t d b y t t m t Tl a r y  
 l w l d b t t l l g Th a r y  
 m k d m f t h l d g l t m m  
 l O M h S f t f l t t e t t l l p t f  
 t h l l t l y f f m m Th  
 l d u f t d  
 O p t U d th x th m d  
 t t g t t s t m t b th y m p h a d  
 t d g d w d t t l l b l f t l y m p h d  
 l m t t t n t b l q

down on each side to the bases of the clitoral glands of the clitoris. From there the incisions turned inward to the anterior aspect of the enlarged urethral orifice thus including in the rhomboidal face designed for excision practically all of the abnormal hairless skin occupying the depressed area at the site of the mons veneris and anterior commissure. Dissection was then carried down to the bladder above the symphysis the peritoneum pushed back and the bladder incised. With retractors in place one could see that the vesical mucosa was smooth pale and normal in appearance in all particulars except that the urethral orifice was dilated. Clear urine flowed from the ureter. The bladder wall was of normal thickness and appeared to be well muscled. The rhomboidal flap at the lower end of the incision was then dissected off and retracted down and the incision carried down on the urethra and symphysis. The cutaneous symphysis was divided and the urethra split all the way up to the bladder so that the entire tract was laid open. In section then showed that the urethra was about 30 millimeters in circumference and that there was no line of demarcation between urethra and bladder. No transverse folds or bands were seen.

A point was selected corresponding by its relations with the ureteral orifices to the vulva of Leutaud and the urethral mucous membrane excised on both sides up to the level of this point leaving a strip about 7 millimeters wide and 12 millimeter long with parallel edges from which the new urethra was to be formed. Incisions were then carried obliquely upward on each side to the cut edge of the bladder completing the excision of redundant mucosa. An artery apparently the inferior vesical was encountered on each side and clamped and ligated. In section then showed some masses of muscle on either side of the site of the new orifice. The vessels were deeply caught up with a suture of No. 6 chromic catgut which came out just at the edge of the mucous membrane. When this suture was drawn together it created a new and small vesical orifice surrounded by a good mass of muscle which was expected to have a phnetic action. The same strand was used at the new urethra reconstructed by a continuous stitch with similar deep bites down to the external orifice. It was then brought back making a second row bringing the new urethra and tied at the level of the vesical orifice.

Another continuous No. 6 chromic catgut suture closed the bladder except at the upper end of the incision where a large bladder drainage tube was left in place. The symphysis was brought together with a No. 3 chromic catgut suture. Closure of the skin for the short distance from the new urethra to the clitoris was by No. 6 plain catgut interrupted sutures the two halves of the clitoris being thus brought together. The remainder of the incision was closed in the usual way metal clip being used for the skin. The suturing of the urethra was done over a silver probe and at the end it was tight enough to grasp the probe moderately. The probe was withdrawn at the completion of the operation.

Rather marked bleeding began 36 hours after the operation but lasted only a short time and apparently did the patient little harm. One small transfusion was given. The tube was removed from the bladder on the twenty-fifth day. The patient was discharged from the hospital on April 9. As much as 120 cubic centimeters could be voided at a time but dribbling was more or less continuous.

June 23. The patient could void about one half cupful every morning at evening but there was still some dribbling. No edema was present. Under antiseptic examination how the entire incision to be healed except the thal of the clitoris were 7 or 8 millimeters apart. The urethral orifice appeared normal and no urine leaked from it. A No. 12 catheter entered the bladder without

difficulty and clear urine was withdrawn. There was no leakage around the catheter when 100 cubic centimeter of fluid were injected.

September 7. Since the previous examination no leakage of urine had occurred at any time day or night in spite of a severe attack of bronchitis 6 weeks before. The usual interval of voiding was 1 1/2 to 3 hours during the day and the maximum intake was 400 cc. per hour. The child usually slept 10 to 11 hours at night without waking. The urine was clear on examination. The patient had gained tremendously in every way.

#### TREATMENT

For purposes of discussion the methods that have been followed in treating epispadias in the female may be classified as (1) plastic operations (2) reefing operations (3) muscle transplantation (4) torsion of the urethra (5) cauterization (6) interposition of uterus (7) transplantation of the ureters and (8) closure of urethra with establishment of suprapubic fistula.

1. *Plastic operations*. These may be divided into (a) external plastics in which the external genitalia have been restored to a condition as near normal as possible and the urethra has been repaired by the excision of portions of its redundant wall reaching upward for variable distances but not far enough to include the sphincteric muscle of the bladder and (b) internal plastics in which the repair has been carried upward to include the region of the internal sphincter the vesical orifice and a portion of the anterior wall of the bladder. Many of the early cases were operated upon by the external plastic method because of a lack of understanding of the internal situation causing incontinence and merely with the thought of restoring the external appearance.

In later developments the idea appeared that the necessary requirement was lengthening and narrowing of the urethra followed later by efforts to create a bend or kink in its course. Surprisingly enough 5 of the cases operated upon in this manner are reported as complete cures. It should however be stated at this point that reports of complete cures unaccompanied by specific statements covering a long period of observation after the operation should be accepted with much reserve. For example one case (No. 30) was reported by Alexander in 1893 as a complete cure. The same case was observed by Ballantyne 3 years later and at that time the incontinence had returned and was complete. It is noted in many cases that while the immediate result may be good incontinence will return a few weeks later as a result of the subsidence of the edema and inflammatory reaction around the urethra.

TABLE II — CLASSIFICATION OF OPERATIVE PROCEDURES USED FOR FPIS/DIAS IN FEMALES AND RESULTS OBTAINED\*

) p x l	W ll		Oc l k g	m mp m		m p m		E	
	l	p	l	l	l	l	p	l	l
E l pl									
E l l l l h f d								25	
E l l l f h d									
R h f l l							oo		
R h f h l							oo		
R f f l eck lrl									
P f f l k d	oo								
T h f l l d									
P l f l l	oo								
P l l l l lpl d	s								7
Pyr m l l pl f d h f	oo								
R l mph									
G l l l l p S h l p b d									
C za							oo	oo	
E f h h f m d f m									
S bm f f l h po h l h d h	oo								

TABLE II—Continued

	W l l		O c l	S o m m r m	N p m t	m
Ope p oc l						
R f	C	I	C	P	C	P
m f i						
i lpl		∞				
C f i j						∞
T i	s		8		9	7
T f i		∞				3
C b h f i			s			s
N pe						

\*Th      l      k   f   m   h      bl   h   l      l      d m y  
b      h      m

*Reefing operations* In another group of cases restoration of the urethra was attempted by means of reefing sutures applied through its walls reducing the caliber without any excision of tissue. Practically all of these attempts failed since they violated a fundamental surgical principle in aiming to cause the cohesion of mucous surfaces in apposition by means of sutures. Here again the areas covered varied widely in some cases including only the external portion of the urethra and in others including the entire urethra and sphincteric apparatus.

3. *Muscle plastic operations* Some surgeons feeling that the faulty development of the muscular apparatus precludes any successful attempt to restore normal conditions by plastic operation have attempted to supply new sphincteric apparatus by transplanting a voluntary muscle in the form of a ring around the urethra. In some cases there was previous reduction in size of the urethra by plastic procedures in other none. The muscles used have been the pyramidalis muscle brought down either with or without a strip of rectus fascia attached behind the symphysis to the juxtavesical portion of the urethra strips of rectus muscle brought down either behind or in front of the symphysis to surround the urethra and the gracilis muscle divided at its midpoint and brought across into the peri-

neum to surround the urethra. Some good results have been obtained from each of these methods.

4 *Torsion of the urethra* This operation represents an effort to bring the walls of the urethra into close apposition by another means. The urethra is freed up to its attachment to the bladder, twisted through an arc varying from 90 to 480 degrees, the latter in several sittings, and sutured into place again at the outer end. This operation has had a great vogue not only in epispadias but in traumatic incontinence of women, but has many disadvantages. It may be followed by gangrene of the urethra or stricture, and in many cases has failed to produce the desired result.

5 *Cauterization* This method has been used but twice, once to cause obliteration of an accessory urethral canal (Case 7) and again in an effort to reduce the caliber of an epispadiac urethra. In the latter case it failed completely as might have been expected.

6 *Interposition of uterus* This operation has been utilized but once. At the same time the vesicovaginal fascia was shortened by a reefing procedure and the patient was sterilized by a resection of the tubes. The result was good but there now seems no excuse for sterilizing the patient in order to cure epispadias.

7 *Transplantation of the ureters* The many failures following plastic and other direct operations have induced two surgeons to attempt transplantation of the ureters into the rectosigmoid. The results have been good in all of the cases reported but here again in the light of considerations to be discussed later, it seems that the procedure is unnecessarily severe and radical.

8 *Obliteration of urethra and establishment of suprapubic fistula* This operation, which is truly a counsel of despair, has been done in 2 cases but requires no further consideration at this time.

Apparently the first operation for epispadias in the female was performed by Roeser in 1860. He excised portions of skin externally so that the halves of the clitoris and the upper parts of the labia could be drawn together. He also excised some of the redundant urethra but only for a portion of its length. As a result of this operation the patient's condition was improved but there was still leakage on coughing or straining and at night.

Pippingskold was the next to operate in 1876 but no description of the operation is given and there was no improvement in the incontinence. Moericke in 1880 made a marked advance. After four unsuccessful external plastics, he dissected the urethra deep into the bladder, including the

region of the sphincter and sutured the edges of the resected area together. He also lengthened the urethra and kinked it up over the symphysis. The result was somewhat better. The patient could retain urine for 4 hours but there was still a little leakage on coughing or straining. In the case of Frommel in 1882 a similar operation was performed and the statement was made that the patient could retain the urine for 4 hours without any leakage. If this is true, it is the first instance of a cure of epispadias in the female.

There were no further innovations until Ger-suny in 1889 conceived the idea of twisting the urethra on its long axis to bring its walls in close apposition. In his case he twisted the urethra in 3 sittings through 450 degrees after which the patient could retain urine for 5 hours and did not leak but had marked difficulty of urination, taking 4 minutes to empty the bladder. Van der Hoeven in the same year excised the entire urethra, forming a new one by a plastic procedure from vaginal mucosa, with what is stated to be a good result.

Himmelfarb in 1893 followed an entirely new plan. His incision was made in the vagina and through this opening he resected an oval piece from the region of the vesical orifice posteriorly, without cutting through the mucosa. The edges of this resected area, presumably made up of muscular tissue, were then sutured together. The urethra was also lengthened and the result was apparently very satisfactory, the patient being able to retain the urine for 6 hours without any leakage 9 months after the operation. Similar operations are still done for traumatic incontinence in women and with success but in epispadias the defect is anterior and the resection and repair should be done anteriorly.

Alexander in 1892 was the first to attempt narrowing of the urethra by means of reefing sutures. In spite of a repetition of the procedure, the failure was complete. Von Mayersbach in 1908 seems to have been the first to suggest strengthening the sphincter by transplantation of voluntary muscle but he used for this purpose some fibers of the constrictor vaginae which could scarcely be expected to be satisfactory for this purpose.

The first practicable contribution on the basis of muscle transplantation was that of Goebell in 1910. He brought the pyramidalis muscles down behind the symphysis pubis and sutured them together beneath the urethra. The results were good. This operation was cleverly devised and took advantage of the fact that the nerve and blood supply of the pyramidalis muscle enter it very near its point of origin and need not be dis-

turbed by the operation. Unfortunately the pyramidalis is often poorly developed so that a number of surgeons who have attempted this operation have not found sufficient material with which to carry it out. The idea was further extended by Thompson in 1923 who finding the pyramidalis deficient cut a long strip from the rectus abdominis and brought it down in front of the symphysis split its end longitudinally and sewed these halves around the urethra. Some of the operations which make use of the pyramidalis muscles have failed probably because of the poor development of the muscle or because of unintentional interference with its nerve or blood supply at the time of operation.

In 1911 Stiles concluded from a study of the literature that all of the operations to date might be expected to fail and therefore treated his cases by transplanting the ureters into the recto sigmoid. Wertheim in 1919 after numerous efforts to help his case by other means including injections of fat and paraffin did a complicated operation in which the uterus was tipped forward and interposed beneath the region of the vesical orifice. While this apparently produced a good result it made sterilization of the patient necessary and has not been imitated by any other surgeon.

It is remarkable that in not one of the cases operated upon up to 1923 is there any mention of a diversion of the urine by means of a drainage tube in the bladder. In some cases the patients were left to pass their urine over the freshly sutured field of operation and in others a retention catheter was left in place for a certain length of time. This seems remarkable inasmuch as other surgeons who had been operating upon urethral defects in the male particularly hypospadias had long before this discovered that diversion of the urine is absolutely necessary in order to secure healing in a sufficiently large proportion of the cases. Apparently the first to put this principle into practice in a case of female epispadias was Young who performed his operation in 1903. This operation is of particular interest from several points of view. The surgeon through his previous work on male epispadias as familiar with the studies of von Kälischer and Zangemeister who showed that in cases of male epispadias the internal sphincter muscle exists as a crescentic mass with its convexity posterior and anterior ends being ununited because of a defect in the anterior wall of the vesical orifice. He therefore deliberately planned to freshen the end of this muscle excise the redundant mucosa between them and suture them

together around the newly formed vesical orifice. In order to do this properly he made a wide exposure of the entire bladder and urethra. Since the patient was only 5 years old he cut through the cartilaginous symphysis and thereby obtained a perfect view of the situation. The resection of the urethra and vesical orifice was a wide leaving just enough mucosa for the reconstruction. A drainage tube was placed in the bladder to divert the urine during the period of healing and the result was entirely satisfactory the patient being free of incontinence.

About the same time Deming operated upon a patient 21 years of age. The operation upon the vesical orifice was done as a separate step but bladder drainage was also used. Owing either to the scars of previous operations to unusually great aplasia of the sphincter or to some other factor the result was not successful so that he had recourse to a muscle plastic using the gracilis muscle. This idea was quite original with Deming and has much to recommend it. The gracilis muscle is larger than any of the other muscles that have been used for the purpose it is not apt to be undeveloped a sufficient length is always available and the blood and nerve supply are so arranged that they are not interfered with if the muscle is cut in its midportion and its upper half carried up into the perineum. This procedure was followed by complete success and has since been successfully repeated by Player and Callendar (50) in a case of male incontinence.

Lowsley's case is an unusual one. The situation as far as the sphincter muscle and urethra were concerned was the same as in cases of epispadias but he states that there was no abnormality whatever of the external genitalia. His plan of operation was similar to that of Young but since his patient was 8 years of age it was not necessary to divide the symphysis in order to obtain suitable exposure. The result was entirely successful. In the case reported in this article the method followed was essentially similar to that of Young. There were slight differences in the trace of the cutaneous incision with the idea of producing a better cosmetic result in the region of the anterior commissure. No instrument was left in the urethra at the close of the operation but bladder drainage was established. It was further found that silver wires were unnecessary for closure of the symphysis chromic catgut sutures proving satisfactory.

#### SUMMARY

In the light of the foregoing considerations it appears obvious that there is no occasion for pes-

simism as to the results of plastic operations for epispadias in the female. In practically every case in which the surgical procedures have been properly planned and executed complete success has been attained. Such operations as transplantation of the ureters should therefore be entirely abandoned for this condition. Even though a satisfactory functional result may be obtained it is unnecessary to subject the patient to the risk of ascending renal infection which is always present after this operation. Gersuny's operation of torsion of the urethra should also be abandoned not only in cases of epispadias but for all cases of female incontinence. The evil results from it are too numerous and include gangrene of the urethra, urethral stricture, urethrocele with stone formation and urethrovaginal fistula while even in the absence of these there are reports of failure to relieve the incontinence. In a case known to the author a retention of urine followed a Gersuny operation and the urethral orifice could not be located when catheterization was attempted. As a result false passages were produced and the patient's condition made worse than before.

The method to be followed is obvious. It should consist of two steps only, the second of which is usually unnecessary. The first should be a thoroughgoing plastic repair of the defect including the following essential points: (1) Wide exposure of the affected areas. (2) Sufficient and thoroughly controlled excision of excessive mucosa done under vision. It is very important to make the urethra small enough if it is too small it can easily be dilated if it is too large the operation is a failure and must be repeated. (3) Careful suture of the halves of the defective internal sphincter muscle over the anterior aspect of the newly formed vesical orifice. (4) Diversion of the urine during the period of healing by a drainage tube in the bladder. This procedure can be relied upon to produce a cure in most cases in which it is properly carried out. Should it for any reason fail the second stage should then be the performance of Demings's gracilis muscle plastic operation. There is excellent reason to believe that these methods can be relied upon to produce a cure in practically every case of epispadias in the female.

## BIBLIOGRAPHY

- 1 ADAMS Glasgow M J 1895 xvi 388
- 2 ALEXANDER J Cutan & Genito Urin Ds 1892 v 53 268
- 3 ANACKER Inaugural Dissertation Straßburg 1903
- 4 ARNAUD Mém de chir 134 Quoted by Morpain
- 5 AUDION Bull et mém Soc anat de P 1900 lxxv 29-31
- 6 AUFFRET Pex de chir 1892 vii 444 44
- 7 BALLANTYNE Ldinbur h Ho p Rep 1896 i 40-277
- 8 BAZY Quoted by Richelot
- 9 BLOCK Inaugural Dissertation Straßburg 1905
- 10 BOY AND DUNCAN Ldinbur M & S J 1805
- 11 BURKHARDT Hndb d Urol 1906 iii 7
- 12 CAMPBELL Tr Am Gynec Soc 1883 viii 146 153
- 13 COUSTOL Bull Soc anat de Par 1895 l 496
- 14 DEMING J Am M Ass 1926 lxxviii 8 8
- 15 DOHRN Ztschr f Gebu th u Gynaek 1886 vi 117-0
- 16 DRANICZ J Akh i Zhen k Bolh z St Peter bu g 1894 ii 567 572
- 17 DURAND Ann de gyn c 1895 xlv 14 1
- 18 EMMET Am J Obst 9 2-73 v 147
- 19 FLEISCHMANN Zentralbl f Gynaek 1911 xvi 14 515
- 20 FRANQUET Quoted by Reiffel chier
- 21 FROMMEL Ztschr f Geburt h u Gynaek 188 viii 430-433
- 22 FUNK Wehnl d k l Ge ell ch d Aerzte in Wien 180 ix (xxvi) 235
- 23 FURST Arch f Kinderh 1892 xiv 430-433
- 24 GERUNY Zentralbl f Chir 1899 l 433 437
- 25 GOEBELL Ztschr f gynack Urol 1910 ii 18-101
- 26 GOSSELIN Gaz d l p 859 xxxvii 4 Quoted by Nunez
- 27 GOTTSCHALK Inaugural Dissertation Wuezburg 1883 Quoted by No e Jo erand
- 28 GUTSCHOW Inaugural Dissertation Roetock 904
- 29 GUYON The e de doct Paris 1863
- 30 HACKENBRUCH Med kl n 1900 v 1150-1153
- 31 HENLE Ztschr f Rati nelle Med 1855 i 343 344
- 32 HIMMELFARB Arch f Gynaek 1893 xlv 3-31
- 33 JOHNSON Young's Pract ce of Urology 1906 ii 104-08
- 34 KRUMHOLTZ Acad de méd Paris 1895 July 30
- 35 KLEINWACHTER Monatschr f Geburt h u Frauenkr 1869 xxvi i 8 8
- 36 KUESTER Wien klin Wehnschr 1896 i 9
- 37 LIEB Zentralbl f Gynaek 1923 xlvii 604-606
- 38 LOWER J Urol 1923 v 149-157
- 39 LOWSEY J Am M Ass 1905 xc 511 5 6
- 40 MARIN Lancet 1894 ii 140 1142
- 41 MALGAUEN Rev med chir de l'ari 1849 vi 374 Quoted by Nunez
- 42 MARION Bull et m m Soc nat de chir 9 4 l 330 333
- 43 MARS Irzegl lek 1900 xxxv 389
- 44 MAYERSBUCH Wien klin Wehnschr 1908 xvi 1813 1816
- 45 MERCIER Rev d orthop 895 vi 352 368
- 46 MOLLER Arch f path Anat 1864 xxv 5 07
- 47 MORICAKE Ztschr f Geburtsh u Gynaek 880 34-333
- 48 MORPAIN Gaz hebdom de med et de chir 8 ii 436 439
- 49 MURATOW Rus k Vrach 1902 xxx Ab tracted Cent albl f Chir 90 v i 1078
- 50 NOBLE-SMITH Brit M J 884 ii 561
- 51 NOVÉ JOIRAND AND COTTE J e de gynéc et de chir 1910 19 7 vi 963 1006
- 52 NUNZ Th e de doct Paris 1895 ci 90
- 53 PANCHENAT Mém Acad roy d c Tu in 1784-85 i 38 390
- 54 PETIT J L Oeu c omplete Trait des Mal Clir 7 4 798 Quoted by Su may
- 55 PETREVICHI J Akh i Zhen k Bolh z 1911 xv ii 147



- 56 P R E N V o d med Ark 804 ( xv ) t  
 5 I I P P I S K O L I n k l k l l k h d l Hel g  
 f 876 i 49 Ab tr ted Jah b u d  
 I t ng u I ts d ge Med 876 300
- 58 P I E A K V a h 900 7 7  
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- 6 P I U T T L R p r t d m l d r g g e n ) 3  
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- 6 I T I ( y é c t b t 9 4 94 i  
 6 P A B t k l C l 807 i 557 594  
 63 R H C H I D Z e t l b l f G y e k 9 l 9
- 64 R I r U ó m d 88 l 36 368  
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 O u t d l ( l t A h f k l n Ch 186 4  
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- 6 R H R M e d I e 800 N
- 68 S A A S T I T S A H L i t p k h r u r g O l h v M k 873  
 75 i 29 Q t I l y B l l a t y n e
- 69 S C I I N D R D e u t h e m e d W l n h 0 0 l 9 0-  
 912
- 7 S A T O N J U l 927 x 663 666  
 7 S I L F S S g G y n e c & O l t 9 t i 7 24  
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- 73 T S T L I J d e m d l e t i h a r m i 854 4  
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- 74 T I I P S N B r t J C l l l D 023 46 5  
 75 I l m C u v H p ( ) 3 i 184
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- 77 T H J A K O W M l O b r 1808 l 6 0-65  
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- 8 W H I A W k l W l n c h 9 0 888  
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THE TREATMENT OF CONGENITAL DISLOCATION OF THE HIP BY OPEN OPERATION<sup>1</sup>

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IN the treatment of congenital dislocation of the hip operative interference presents certain advantages over mechanical and closed manipulative methods—advantages that justify a more extensive use of the open procedure. Operative treatment affords the opportunity to examine the existing pathology. Not infrequently the study of the pathological changes reveals a dislocation so marked or a capsule so misshapen or an acetabulum so filled with adherent tissue that the impossibility of obtaining reduction by closed manipulative treatment is immediately recognized. The surgical dangers of open operation are very slight; shock is seldom experienced and there is little damage to the tissues. On the other hand, so much force may be required to reduce a dislocation by manual procedures or traction machines that the soft parts are severely traumatized. Open intervention is the only procedure possible in adult cases of dislocation which unless relieved come to extreme disability since the patient suffers from symptoms of an arthritic nature as well as from instability.

The hesitancy of operators to use the open method more widely may be traced to the conservative teachings of many of our instructors. Then too manipulative procedures have been practised so long in many of the children's hospitals that the adoption of the open method might be interpreted as an admission of the failure of the closed manipulative measures. To those who have been trained recently in surgical procedure and who have learned the technique of the open method from a competent surgeon the open approach is logical.

## INDICATIONS

In children from 4 to 8 years of age operative interference is indicated to effect reduction when one or two closed manipulations have not been successful.

In children more than 8 years of age and in adolescents open operation is the method of choice for reducing a dislocation. Manipulative treatment in such cases is liable to result in extensive trauma, especially is this true if the child is of the resistant type.

In adults whose age excludes the possibility of obtaining a satisfactory functional result, open

operation is indicated to correct deformity if present and to relieve pain and stiffness thereby avoiding arthritic complications which eventually develop in such cases.

## PATHOLOGY

The chief obstacles to reduction lie in the alteration of the soft structures and in the anteversion of the femoral head and neck. In some cases changes in the acetabulum make reduction difficult.

The superior capsule is extremely dilated as the result of the pressure of the femoral head against it when the patient bears weight. The inferior capsule is adherent to the acetabulum and often fills the cavity except for a small opening through which the teres ligament passes to join the head. At the upper posterior rim of the acetabulum where the teres ligament comes out the capsule is usually contracted in the shape of an *hour glass*. This contraction of the inferior capsule and its adherence to the acetabulum form the great barriers to reduction by closed manipulative methods.

The femoral head and neck practically always show anteversion and not infrequently the neck is shortened and misshapen as well as twisted. This rotation of the head and neck constitutes another obstacle to reduction.

The acetabulum assumes a triangular shape. Its rim becomes flattened as the result of the pull of the capsule upward. The socket appears to be shallow. In some cases the cavity actually may be of little depth but as a rule the shallow appearance is due to the fact that the acetabulum is filled with connective tissue which is completely covered over by the adherent inferior capsule.

## OPERATIVE TREATMENT

*The selection of the operation.* Once open operation has been decided upon the choice of the operative method will be determined by the following factors: the age of the patient, the position of the femoral head and the pathological condition of the acetabulum. The operator may advise a simple replacement of the femoral head, a reconstruction operation on the acetabulum or head, or an arthrodesis.

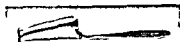


Fig. 1. (g) (h) (i) (j) (k) (l) (m) (n) (o) (p) (q) (r) (s) (t) (u) (v) (w) (x) (y) (z)

Simple replacement is the ideal method of treatment for it insures both a good anatomical and functional recovery. This procedure is applicable to cases in which the acetabulum is of sufficient depth to return the femoral head and in which the shape of the head itself is normal or nearly so. The technique by which the head is restored to position varies with the operator. If marked internal rotation persists after reduction it may be corrected by an osteotomy of the femur.

*The author's method of reduction.* A 2 day preparation is given to the operative field which includes the knee joint, the inner and posterior parts of the thigh up to the groin and the section of the trunk between the anterior midline and the posterior midline of the body and extending well up to the crest of the ilium. The patient is draped with the affected leg left exposed as to facilitate manipulative treatment.

An incision 6 to 8 inches in length is made beginning at the anterior superior spine and extending downward in a slightly curved direction to the outer part of the thigh. The skin edges are wiped with alcohol and washed off with towels. A longitudinal incision is made through the fascia, care being taken not to carry it too low because of the danger of injuring the internal saphenous nerve leading to the vastus externus. The external femoral artery, which usually lies in the lower part of the wound, is clamped off and tied. The rectus femoris and the sartorius are defined and retracted to the inner side and the tensor vagina femoris and the gluteus maximus and medius are exposed and retracted to the outer side. All tissue about the capsule is pushed back by blunt dissection.

An incision running parallel to the shaft of the femur is made through the capsule and lengthened at each end by means of heavy scissors. The capsule is examined for constrictions. The hour glass contraction usually found between the femoral head and the acetabulum is divided. The capsule is forcibly dilated to expose the head of the femur. Sutures are placed in each side of the capsule in order to facilitate suturing when reduction has been made.

The joint cavity is explored with the index finger. The femoral head is usually found in a high posterior position. The teres ligament is



Fig. 2. (g) (h) (i) (j) (k) (l) (m) (n) (o) (p) (q) (r) (s) (t) (u) (v) (w) (x) (y) (z)

located and will be found to lead to the old acetabulum. Any obstacle to reduction is overcome, the inferior capsule is cleared away from the acetabulum with a chisel and all soft tissue is removed from the cavity. Occasionally it is necessary to sever the attachments of the pectineal muscles on the inner side of the femur. If the teres ligament is thickened it should be excised.

Reduction of the head is now obtained by a combination of abduction and internal rotation movements. A special instrument, the conical hip skid devised by the writer (Fig. 3) is placed under the femoral head with its lip extending just inside the superior rim of the acetabulum. The operator pushes on the trochanter and at the same time lifts the skid to secure leverage while an assistant brings the leg into abduction, strong inward rotation and hyperextension. Considerable inversion is required to force the head into proper apposition with the acetabulum. When the femoral head reaches the cavity it snaps into place. It is locked securely in position by further abduction and inward rotation of the head.

The capsule is overlapped and the chromic gut sutures are tied securely. The muscles fall back into place, the operator using a catgut suture to prevent blind pockets. The fascia is closed with continuous chromic catgut and the skin with continuous catgut. A plaster spica is applied from the breast line to the ankle with the hip in abduction and inward rotation and with the knee flexed (Fig. 4).



FIG. 3. Case 1. Poentgenogram showing the femoral head in position after operation.

The spica is worn for 8 weeks. At the end of this period a new one is applied with the hip in 15 degrees to 30 degrees abduction and in marked inward rotation with the knee extended. A plaster spica is used to maintain the hip in position for 6 to 10 weeks depending upon the stability and the mechanical problem involved.

*After care.* When the plaster spica has been removed the hip, thigh and calf should be massaged and put through passive movements daily. The patient should be taught to walk properly with the feet straight ahead to favor the return of muscle balance. Swimming is the ideal form of exercise.

*Osteotomy of the femur.* In an occasional case the internal rotation may be so marked as to require an osteotomy of the femur. This procedure is often necessary in cases of older patients. It should not be performed until motion in the hip is well established.

The technique of osteotomy of the femur is as follows. The femur is exposed through an incision 3 to 4 inches long made just below the trochanter. A longitudinal incision about 1½ inches in length is made in the periosteum. A transverse osteotomy is done and the lower part of the femur is rotated outward until the foot in recumbency points directly upward. The periosteum is sutured and the wound closed in the usual manner. A plaster spica is applied and worn for 8 to 10 weeks. Weight bearing is permitted during the latter part of this period.

*Reconstruction operations.* The object of a reconstruction operation is first to restore stability to the hip so that it can support the weight of the body without pain and second to procure motion sufficient for ordinary movements.

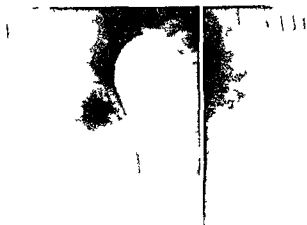


FIG. 4. Case 1. Poentgenogram showing the right femoral head in position nearly 11 years after open operation and the left femoral head in position nearly 11 years after manipulation.

Reconstruction operations are used in cases in which a permanent reduction cannot be insured because of the extreme hypermobility of the hip joint due to the shallowness of the acetabulum or to the distortion of the femoral head. Reconstruction methods are also applicable to cases in which an attempt at reduction is useless either because of the advanced age of the patient or because of severe structural changes such as extreme alteration of the tissues, a great amount of shortening or elevation of the hip. The best known methods of reconstruction are the bone flap method of Albee (1) and the bifurcation method of Lorenz (38) and von Bayer (5).

*Reinforcement of the acetabulum following reduction.* The femoral head is reduced by the author's method. A curved shelf of bone about 1½ inches wide and 4 or 5 inches long is raised from the outer table of the ilium behind and just above the femoral head. This bone flap is bent downward gradually until it projects outward at a right angle to the ilium. The shelf thus formed may be reinforced with a bone graft or chips of bone. This wedge acts as an obstacle to the recurrence of dislocation. The wound is closed and a plaster spica applied from the toes to the nipple line with the leg abducted to about 30 degrees.

*The formation of a new acetabulum in irreducible cases.* This method may be used in cases in which an attempt at complete reduction would cause extensive trauma. Operators differ as to the selection of the site for the construction of the new acetabulum. Albee (1) forms a new socket on the ilium higher up than the original



I

I b o

I

I g 8

l h C 3 l tge m h l l t f  
 d h b t f f t t  
 l b C 3 R t k m h g d l t n f  
 d l f t h p l f p u

Γ C e 3 R e t g m h o g t h l e f t h p  
 t l t f l d t  
 I g 8 C e 3 R n g m h g t h e p o t n o f  
 l t h l p a f t p r d c t o

acetabulum Gill (5) begin the new cavity at the site of the old acetabulum and continues the enlargement upward until the head can be placed in it. Balensweig (3) forms a new socket in the upper half of the old acetabulum. Speed (53) determines the level of the new cavity by bringing the femoral head into position by abducting the hip flexion it to about 60 degree and marking the place where the head rests on the ilium. A new socket is formed at this point.

*The formation of a supporting shelf of bone with construction of a new acetabulum in irreducible cases.* The chief cause of pain and disability in irreducible cases is the lack of a bone support for the femoral head. The creation of a smooth gliding surface for the head by the same technique as described under *The reinforcement of the acetabulum following reduction* increases stability, relieves pain and thereby improves function. This method is applicable particularly to adult cases.

*The bifurcated method of Loren (5) and von Baye (5) in irreducible cases.* This procedure consists of an oblique osteotomy of the femur just below the trochanter and the insertion of the proximal end of the lower fragment into the acetabular socket where it rests against the femoral head. When properly done this operation gives good results.

*Arthrodesis.* In adult cases in which there is instability, stiffness, pain and deformity, arthrodesis is indicated to relieve the symptoms. A hip ankylosed in good position is preferable to one that is unstable and painful.

#### CASES OF REDUCTION

C B C a g d 4 e w f t e 1 F t n u r y  
 9 Th d g f l l w f t d d  
 l a t f t h l f h p m d e Th p t t h d f d

n t t k f f t l p l y t the a g f r y  
 b t t h l l t d h p p b b l y o f g e t a l m  
 T t t I N e m l 92 a t t e m p t w m a d t  
 r d c t h h p l m l t b t t a o t f l  
 O n d m l 8 19 l n r d t a p r m e d Th  
 f l l d I l u a r y o 92 h y t e o t m y f  
 t l f m O A g u t 24 19 t h h p m p l a t e d  
 u n d t h e  
 R H I J u n 93 t h h d w t a b l e Th e w a  
 m t t l 10 3 d g d n t l o t t f  
 o l g l t t t n w m l F t  
 6 y d i n p t t t t g l A p l 97  
 h p t l T l e w m t o n f l n t 9 d a d  
 l t t t a b o t h l f n m l E t l  
 t t m l (I g 3)  
 C s M C g d o g a a N m b  
 o 5 l d g n f c g t l d l o t f l t h  
 h p m l  
 T t t I N l 95 A p o p t  
 p f m d n t h g h t l Th p t e t h e a  
 p l t p a f l y e I N e m b 96 t h  
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 T l A f l f o d g e e d g o d a i d t b d c  
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 l m p T l e f l t p h d s e o f 6 d g e e d o m l  
 l d t d a d d c t J 8 92 n e l y a  
 a f t t h e a t o t h g t h h d f f 8 d g e  
 l t h t a l a d t e l o t t c l l t Th l t d  
 h h d f f 5 d g d m l a b d t a d  
 d d t n (I g 4)  
 C s 3 A S d d 53 f t n i s p t m b  
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 l f l g s t t d t l l y 3 d g d t h g h t  
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 T t t O y t t m t n h y t h  
 w t h l p h d l m p l t d I O t b o  
 p l t f t h l f l p w d b y t t  
 (I g 7) O n y e l a t t h g h t h p d e d b y t h  
 p m t d  
 R H I J l 93 l o t h h p h d f o f 9 d g e  
 a b d u t f 35 d g a d h y p t o n o f d b  
 I t g t l m p e d d t h h d l k d  
 w t h t a l m p O A p l 27 97 t h h l h d f n t  
 5 d g l b d t f 5 d h a n t r a m  
 (I g 8) h o d t h h p t b e i g d p t



Fig 9

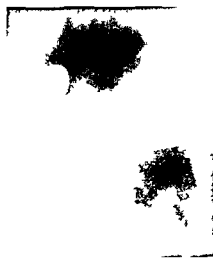


Fig 10



Fig 11

Fig 9 Case 4 Roentgenogram showing location of the left hip before operation

Fig 10 Case 4 Roentgenogram showing the hip in plaster after open reduction

Fig 11 Case 4 Roentgenogram showing the hip in position after open reduction

CASE 4 I D aged 4 years was first seen in July 1900 and a diagnosis of congenital dislocation of the left hip was made (Fig 9).

Treatment An open operation was performed according to the usual technique (Fig 10).

Result In September 1900 the head of the femur was in good position. There was no shortening. In March 1911 the patient could flex his hip to a right angle. In July 1923, 3 years after the operation, the patient walked without a limp. Flexion, extension, abduction and inward rotation were normal. The result was considered perfect (Fig 11).

CASE 5 F H aged 3 years and 10 months was first seen on April 1913. This child walked with a distinct waddling characteristic of double congenital dislocation of the hips (Fig 12).

Treatment On June 1, 1913, an open operation was performed on the left hip according to the usual technique. The neck of the femur was found twisted and the head was flat. Reduction was accomplished with difficulty. A plaster cast was applied with the leg in the position of abduction, internal rotation and hyperextension (Fig 13). On July 1, 1913, a new plaster cast was applied with the internal rotation and abduction reduced one half. The plaster was removed on September 4, 1913. At that time the hip had 15 degrees abduction and rotation was free. The leg was in slight rotation. Neither stat nor manipulation into abduction. Massage of the thigh and calf was advised. On March 18, 1914, the right hip was manipulated under ether and reduction effected. A plaster cast was applied with the leg in a position of abduction, internal rotation and hyperextension. On July 8, 1914, a new plaster cast was applied with the leg in the same position. On September 2, the plaster cast was removed and a flannel one applied. On March 1, 1915, the right hip was manipulated into extreme abduction and a plaster cast applied. This plaster was removed on September 1, 1915.

Result On September 9, 1912, the right hip was in good position and had motion from 30 degrees to 40 degrees. The left hip had flexion to 80 degrees and rotation was good. On January 19, 1916, the right hip had 85 degrees to 90 degrees flexion and a few degrees rotation. The left hip had 20 degrees flexion and a few degrees rotation. Both hips were in position (Fig 14). On April 1, 1917, nearly 4 years after the open reduction

of the left hip, all motions were normal. Both extremities were of equal length. The result was excellent.

CASE 6 H S aged 3 years was first seen on May 12, 1923. This child walked with a dip of the right hip. Flexion was normal but abduction was limited. A roentgenogram (Fig 15) showed a high posterior location.

Treatment On June 1, 1923, an open reduction was accomplished with difficulty. The inferior capsule was found to be adherent to a shallow acetabulum. A plaster cast was applied from the rib to the ankle with the leg abducted, rotated internally and hyperextended (Fig 16). The spica was changed on July 10, 1923. When this was removed on September 4, 1923, the hip went easily into 15 degrees abduction. Internal rotation was possible to a few degrees. Forcible abduction and massage were to be continued.

Result On January 19, 1924, the child was walking. She had about 80 degrees motion in flexion and good rotation. On June 10, 1924, motion in flexion was increased to 90 degrees. Rotation was good. There was shortening of 3/4 of an inch. The patient walked with only a slight limp (Fig 17). On April 2, 1925, nearly 4 years after reduction, the hip could be flexed to a right angle. Rotation was about two-thirds normal. Abduction was almost complete. There was about 1/2 inch shortening, which probably will be compensated for before adult life. The result was excellent.

CASE 7 S G aged 9 years was first seen in October 1923. This child walked with a limp of the right leg. A roentgenogram (Fig 18) showed the trochanter to be high and posterior.

Treatment On December 11, 1923, an open operation was performed according to the usual technique. It was necessary to rotate the thigh 90 degrees in order to face the head into the acetabulum.

Result On February 6, 1924, the plaster cast was removed. The hip had 30 degrees to 40 degrees motion in flexion and free abduction and adduction. On March 8, 1924, the hip was in plaster. The child had about 2 degrees motion without pain and could abduct the hip. On April 3, the hip had 40 degrees flexion and good motion in abduction and adduction. On September 16, 1924, the child walked with a slight limp. Manipulations were advised. A roentgenogram (Fig 19) showed the hip to be in excellent position.



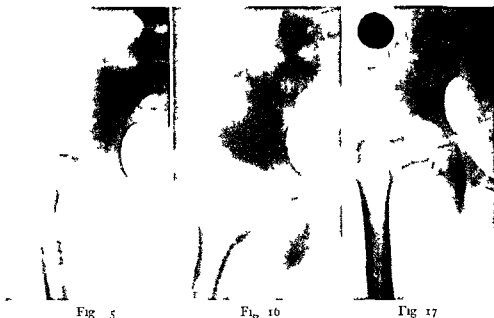


Fig. 15 Case 6 Poentgenogram showing location of the right hip before operation  
 Fig. 16 Case 6 Roentgenogram showing the hip in plaster after open reduction  
 Fig. 17 Case 6 Roentgenogram showing the right hip in position after open reduction

Among the early methods of treatment were manipulation of the hip into extension in an attempt to draw the femur into position (Dupuytren 19) subcutaneous operations with or without manipulation of the hip into extension (Bouvier 7 Pravaz 46 Corridge 15 and Brodhurst 10) tenotomy of the peritrochanteric muscles (Guerin 26 Barwell 4) resection of the femoral head (Roser 49 Reyher 47) formation of a new acetabulum (Koenig 31 Tubby 55 Margary 41 Poggi 45 Ogston 42) and fixation of the femoral head to the iliac bone by means of nails (Witzel 58) or ivory pegs (Kirmisson 30). All of these methods are only of historical interest. In general they yielded unsatisfactory results.

In 1890 Hoffa (8) brought forward the first procedure that offered a possibility of relief. In brief his method was as follows: The capsule was exposed by an oblique incision made along the posterior border of the greater trochanter between the tensor vaginae femoris and the gluteus medius. In the early application of his method Hoffa severed all the muscles attached to the greater and lesser trochanters but later he revised his technique to avoid this step. The acetabulum was deepened in forward and upward directions with large spoon curettes. The femoral head was replaced. A plaster spica was applied with the leg in slight abduction. In some instances Hoffa performed tenotomy of the hamstring tendons and divided the fascia about the ilium.

Lorenz (39) modified Hoffa's technique making an incision on the anterior external surface

and sparing the muscles. From 1892 to 1896 Lorenz performed 23 open reductions. Good results were obtained in but few cases. In general the mortality was so high owing to loss of blood and sepsis that Lorenz finally abandoned the method.

While attempts were being made to obtain reduction by open intervention a number of surgeons in particular French orthopedists were experimenting with various closed manipulative processes and mechanical appliances. Through the efforts of Pravaz (46) Paci (43) and Lorenz (39) a bloodless manipulative process was worked out. Between 1895 and 1904 this method became recognized as the routine treatment of congenital dislocation.

Open interference however was not entirely abandoned. All surgeons among whom were even the strongest advocates of the bloodless operation agreed that it was necessary to resort to open intervention in cases of marked displacement with a constricted capsule and in long standing cases. Several orthopedists realizing the great danger of traumatism in manipulative handling urged a more extensive use of the open procedure. Sherman (51) in a presentation before the American Orthopedic Association in 1904 pointed out in detail the traumatic danger which the manipulative treatment entails and called attention to the impossibility of securing reduction by this method in cases in which the capsule is narrowed. In 8 cases which Sherman explored he found only one in which the





Fig 1 (l ft) C R tg m h g t l l  
t f th l t p b f p t m h n th g l t  
I g o C R tg p m h n th g l t  
h p p t f t p d t

narrow part of the cap ule was of sufficient width to allow the passage of the femoral head

Sherman's (5) technique is as follows. An incision is made from the anterior superior iliac spine downward just external to the long head of the rectus femoris. The capsule is incised freely in line with the incision already made. The hip is flexed. A long-bladed bistoury is guided by the gloved finger into the acetabulum. The capsule is cut downward by pushing the finger against the blade inside the capsule and moving the handle of the bistoury to and fro with the hand. The operator can then hide his finger along the knife into the acetabulum. The head is placed in the socket. The thigh is extended abducted to approximately 75 degrees and rotated inward to 90 degrees. The knee is flexed. When the hip and knee are in these positions the long head of the rectus is tight and lies directly over the femoral



Fig 2 (l ft) C R tg og m h g f m al  
l d po t I C o R e t g e g m h g th r g h t h p  
I t f t e p d t

neck, anterior luxation is prevented. The capsule on the inner side of the incision is not sutured but is carried downward and inward with the neck as it moves with the head into the acetabulum. The fascia lata is sutured with catgut and the skin with horse hair. A plaster of Paris splint is applied and worn for 4 to 6 weeks. If necessary, an osteotomy may be performed to fit the component parts.

Sherman reduced 58 cases by this method in 9 of these cases reductions alone were performed and in the other cases supplementary osteotomies were done. Twelve of the first group obtained functionally normal joints. 8 have gone into anterior transposition, 3 have stable reposition and 1 has become ankylosed. In the other group in which reduction was

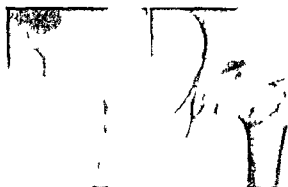


Fig 3 (l ft) C Ro tg g m l w g d l  
t f th l f t h l b f p t  
I g 3 Ca I tg g m l w g the l f t l p  
I t t t t d t



Fig 4 (l ft) C I tg g a m h g d l  
cat f the l f t h p  
Fig 5 Ca I R tg og m h g th l f t h p  
I p t n f t e r o p e d u t



Fig 6 (left) Case 1 Roentgenogram showing dislocation of the right hip before operation

Fig 7 Case 12 Roentgenogram showing the right hip in plaster following open reduction

followed by osteotomy 70.3 per cent successful results were obtained

In 1920 Galloway (23) following in the path outlined by Sherman began to use open interference in selected cases. His success with the method led to his resorting to open operation in all cases. Galloway considered that the best ages for open reduction were from 6 months to 2 years.

His method is as follows: The capsule is exposed by the Smith-Petersen incision. The limb is rotated inward and the capsule opened by a crucial incision. The limb is then rotated outward exposing the teres ligament. This will be found to lead to the acetabulum. Any constriction of the capsule is freely divided. If the acetabulum is filled with fibrous tissue, as usually occurs in children over 3 years of age and not infrequently even in younger patients, the mass is carefully stripped from the roof and walls of the cavity and pushed toward the floor. The head is reduced, the hip skid being used if necessary. The wound is sutured in layers. The capsule is not sutured. A plaster spica is applied with the hip in the position of abduction. Three weeks after application the spica is changed and weight bearing encouraged. The plaster bandages are changed at 6 to 8 week intervals and at each change the abduction is reduced.

During the 6 years from 1920 to 1926 Galloway (24) operated on 38 cases using various methods including the reduction method already described, arthrodesis, reinforcement of the acetabulum and the formation of a new socket. Nine were cases of bilateral dislocation. Fifteen results were excellent, 18 were good and 5, although doubtful, were not failures. It is an interesting feature that with one exception the patients who were cured were between 17 months



Fig 8 Case 12 Photograph showing alignment of limb after removal of plaster

and 2½ years of age, while those who obtained good results were between 3 years 9 months and 9 years.

Many different methods of reduction have been devised. Inganni (9), Ricard (48), Corner (14), Frisch (2), Lambotte (34), Lever (37), Tubby (55), LeDamany (35), Thomas (54), Patschke (44), Ludloff (40), Fairbank (6), Davis (16), Allison and Dixon (2), Willis (57), Bernstein (6), Clarke (1), Bradford (8) and Burghard (11) have reported cases of open operation. One of the largest groups of cases comprising 35 was reported by Deutschlaender (17) in 1921. Deutschlaender called particular attention to the necessity of relaxing the iliopsoas for only when this muscle is at rest is it



Fig 9 Case 1 Roentgenogram taken after removal of plaster

possible to gain entrance to the head of the femur. Thirty of the reductions resulted in both anatomical and functional improvement.

In cases in which reduction was impossible operators have used the bifurcation method of the bone flap method and the process of constructing a new acetabulum—procedures that have been mentioned under the discussion on treatment. Lorenz (8) used the bifurcation method in 60 cases with excellent results. Some of the patients showed no signs of crippling and could run and jump. This operation has the advantage of relieving deformity even though the result as to function is not entirely satisfactory. Kortzeborn (3) secured most gratifying results in 2 cases operated by this method.

Among those using the bone flap method is Dickson (18) who applied it in 5 cases of old dislocation. The disability in the cases consisted of (1) a short limb (2) an unstable joint and (3) abnormal posture. Four cases resulted satisfactorily with a gain in motion and a decrease of the shortening. In the fifth case infection gave rise to limitation of motion.

Fairbank (20) reported a group of 11 cases in which he formed a new acetabulum by turning down a peritæal flap from the ilium over the upper margin of the acetabulum. In 3 cases the results were satisfactory, in 4 there was anterior reposition, in 1 arthritis developed and 1 case relapsed. It was impossible to obtain information in the other cases.

Speel (31) reported 8 cases in which a new acetabulum was formed on the lateral surface of the ilium. His results were disappointing, stability was gained but motion was restricted. Adductor contractures developed in 3 cases. Limp persisted in several cases.

The construction of a new acetabulum in the vicinity of the normal cavity was tried by several operators including Codivilla (1) and Fort (36). Krause (3), Burghard (11) and Davis (16)

#### CONCLUSIONS

The operation which affords the opportunity to study the pathology and which involves much less labor than forcible manipulative and mechanical procedures may be used to advantage more often than is the customary practice. Examination of the pathological changes often reveal an hourglass shaped constriction of the capsule or marked anteversion of the femoral neck or an acetabulum filled with adherent tissue covered over with the inferior capsule. In the presence of such alterations the closed method is futile.

Operative interference is indicated in children from 4 to 8 years of age when one or two closed manipulations have failed. In older children it is the method of choice and in adults it is indicated to correct deformity and relieve arthritic symptoms.

Simple replacement of the head within the socket is the ideal method of treatment. If age or extensive pathological changes exclude the use of this method reconstruction operations may produce results which are functionally and anatomically satisfactory.

#### BIBLIOGRAPHY

1. ALLEN, J. M. A. J. 9, 134, 6
2. B. L. H. J. T. B. & J. t. S. g. 9, 6, 11, 334
3. B. L. H. J. T. B. & J. t. S. g. 9, 6, 11, 334
4. B. L. H. J. T. B. & J. t. S. g. 9, 6, 11, 334
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89. B. L. H. J. T. B. & J. t. S. g. 9, 6, 11, 334
90. B. L. H. J. T. B. & J. t. S. g. 9, 6, 11, 334
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98. B. L. H. J. T. B. & J. t. S. g. 9, 6, 11, 334
99. B. L. H. J. T. B. & J. t. S. g. 9, 6, 11, 334
100. B. L. H. J. T. B. & J. t. S. g. 9, 6, 11, 334

- 4 OOSTON Brit M J 1883 II 1116  
 43 PACI Arch di ortop 1896 VIII 30  
 44 PAT CHKE Deutsche med Wchnschr 1911 XXXVII 1689  
 45 POGGI Arch di ortop 1890 VII 103  
 46 PRAVAZ Traite theorique et de luxation congenitales du femur Lyon 1847  
 47 REYHER Zent albl f Chi 1884 VI 32  
 48 RICARD Bull et m m Soc de chir de Par 1910 XXXVI 382  
 49 ROSE Ve handl d Ge ell ch f Chir 18 9 III 46  
 50 SCHREGER Reported by Jone J P Med & Surg Rep Episcopal Hospital Philadelphia 1914 VI 261  
 51 SHERMAN J Am M As 1903 LXVI 31  
 52 Idem Surg Gynec & Obst 1914 LXII 18  
 53 SPEED J Am M As 19 6 LXXXVII 1631  
 54 THOMAS J Am M A 1922 LXXXIII 3 3  
 55 TUBBS Deformity London 912  
 56 Idem Med Pres & C C 1910 LXXXVI 6 3  
 57 WILLIS Northwe t Med 1907 V 380  
 58 WITZEL Zentralbl f Chir 1901 XXXIII 97

A FURTHER STUDY OF CLEFT PALATE<sup>1</sup>

By A MACKENZIE FORBES M.D. MONTREAL  
 Ch cal P f so f O th ped S g y M G H U ty

IN the early part of 1927 a clinical study of what was considered to be a new method for the treatment of cleft palate was described in the *Canadian Medical Association Journal*. This study of cleft palate was based on the development of the superior maxillary bone.

At birth and during infancy the measurement of the superior maxilla is greater in the antero-posterior direction than in the vertical direction. In adults the vertical measurement is greater. In studying cleft palate one is impressed with the fact that this deformity is not due to lack of development but rather to lack of fusion of the component parts of the superior maxillary bone.

Sir Arthur Keith has said that in the majority of cases of complete cleft palate there is no deficiency of tissue at birth nor for some time after birth and that he also agrees that the cleft however wide is not due to a deficiency of tissue in the several elements which form the palate but is entirely due to the fact that when the various embryonic parts or elements are developed and come together in the second month of development the process of union which should occur then by a means similar to union by first intention is delayed and does not take place hence the several palatal elements being inco-ordinated by union tend to separate as growth occurs and the cleft increases during each month of growth.

The aim of those who would treat cleft palate by the method to be described presently is to remodel the upper jaw so that its vertical dimension is increased at the expense of the anteroposterior and lateral dimensions.

Let us examine the roof of the mouth with its hard and soft palates. Included in the former are the maxillæ and premaxillæ and the alveolar processes of the c bones. The roof of the mouth may

be pictured as a horseshoe. We note that in a desire to close the cleft of the palate it will be advisable to approximate the lateral parts of this horseshoe without causing too great protrusion forward of the anterior parts represented principally by the premaxillæ and also by the anterior cornua of the superior maxillæ.

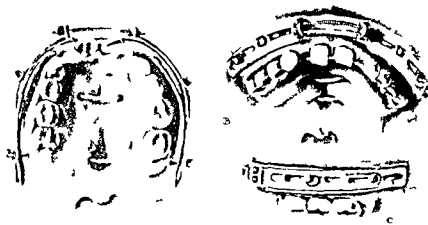
We must aim to stimulate the normal development of the superior maxillary bone by increasing the vertical measurement of the upper jaw as opposed to the anteroposterior measurement. This we feel can be done.

*The object.* In planning our *modus operandi* we must bear in mind the importance of the fact that our object is not only to make lateral pressure to close the cleft but to regulate this lateral pressure because such lateral pressure might force the premaxillæ and adjacent parts too far forward.<sup>1</sup>

Our aim is to reduce the transverse and anteroposterior dimensions of the roof of the mouth by heaping up the tissues in front and on the sides in much the same way as a farrier remodels a horseshoe by hammering every section of red hot metal in order to reduce its size and increase its strength by changing its form.<sup>2</sup>

To do this pressure must be exerted on the outer surface of both maxillary and premaxillary alveolar processes. No part must be left unguarded. Pressure is made by the application of plates of German silver molded to conform to the outer and anterior aspects of the alveolar arch. I res

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The first step in the operation for the relief of cleft palate by this method is to introduce two transverse wires from the alveolar process of one side to the alveolar process of the other side. This is done with difficulty. We try to place these wires as high as we are able in younger patients if possible above the hard palate. We must not interfere either with the erupted or unerupted teeth. We endeavor to insert these wires in positions most advantageous to exert pressure by traction in order to modify growth and deformity. The posterior transverse wire must be placed as far posterior as possible and the anterior transverse wire must be placed not too far from the anterior extremities of the superior maxillæ.

The plates are fitted to the c wire by means of small nuts which are used to regulate the pressure brought to bear on the silver plates. As the plates are fairly rigid this pressure is distributed evenly throughout their length.

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maxillary alveolar process. A slot is cut in the long axis of this plate so that it may be maintained in position on the transverse wires already described and so that it may be forced in a posterior direction by traction on the lateral plates.

The two lateral plates are fashioned to cover the external surface of the maxillary alveolar processes. These are very much the same size as the lead plates at one time used by Brophy for a somewhat similar purpose. The anterior extremity of each of these plates extend forward to about the position of the lateral incisor tooth on each side and is turned outward at a right angle to the plane of the plate. This out turned extremity is perforated for two traction wires fitted with nuts which are used to connect the out turned extremities of the two lateral plates. A slot is cut in the long axis of each of these plates so that these plates also may be maintained in position by the anterior transverse wires already described and yet be freely movable in an anterior direction. These lateral plates are perforated posteriorly for insertion into the posterior transverse wire which anchor these plates. No movement is possible at the point of insertion of the posterior transverse wires into the perforation as the plates are fixed to the posterior transverse wires with two small threaded nuts.

These three plates may be fashioned on a dentist's plaster cast of the alveolar processes and roof of the mouth. These plates are made of a hard metal such as German silver but if advis-

able lead plates of a similar size may be inserted underneath these rigid plates for the purpose of protecting the gums

*Interoposterior compression* After the three plates are in position two threaded wires are inserted between the out turned extremities of the lateral plates the latter being superimposed on the anterior plate. These threaded wires are for the purpose of traction and are fixed in position by nuts. It will be seen that these wires connect the anterior out turned extremities of the lateral plates and thus maintain these plates in position. The lateral plates can by this connection well control the anteroposterior pressure exerted by the anterior plate through traction on the lateral plates. This traction is made by the nuts which maintain these two anterior traction wires in position. These nuts regulate the compression made on the palate.

It will be seen now that if traction be made on the two lateral plates by tightening the two traction wires pressure by traction will force the anterior plate backward and bring the posterior and lateral surfaces of the alveolar processes forward so that the whole superior maxilla will be compressed by pressure exerted in all directions over the external surface of the alveolar processes. The backward sliding of the anterior plate is made possible by the fact that thus and the lateral plates have been fashioned with slots into which the anterior threaded wires fit. The arrangement of the slots on the anterior plate and the two lateral plates are complementary to each other. The anterior transverse wire fits into both of these and maintains the level of these plates on the outer surfaces of the alveolar processes. Pressure in a posterior direction as well as traction in an

anterior direction is assured by tightening the anterior or traction wires. As the anterior plate is carried backward and as pressure is exerted on the lateral plates by tightening the nuts on the transverse wires the alveolar processes of the maxilla and premaxilla will be remodeled in such a way that both the internal and the external architecture will be changed and growth must of necessity be in a vertical direction viz from below upward instead of in an anteroposterior direction.

The extraordinary power exerted by this apparatus has been proved by test. It is a power which must be used wisely. Whether it is best to attempt immediate or forcible correction or rather the gradual correction of the orthodontist will depend largely on the character of the deformity and the age of the patient.

The future changes in the architecture of the alveolar processes and the influence exerted on the eruption of the teeth are not fully known.

Whether this method will be found useful in other conditions such as fractures and orthodontic affections is open to question. Yet we feel that this study of cleft palate has been worth while because a method has been evolved which has already manifested its usefulness in certain cases.

In some cases modifications in the technique have been made so as to meet special conditions.

*NOTE*—In this study I have been but the directing spirit. A group composed of Doctors H. L. Derome, J. D. Angus, C. M. Kirk and R. Breitman have all contributed. The plates or plate which we use are made in a machine most ingeniously planned by M. R. Frank, Graduate of Montreal and made available for our use by the excellent contribution of the All-Masculine Fund of the Province of Quebec.

# ENDOMETRIAL ADENOMATA IN ABDOMINAL SCAR FOLLOWING CESAREAN SECTION

By WILLIAM J. GUINAN, M.D., B.T.  
I m h s l f h p B t b h m H p l

**A**DENOMATA of endometrial type occur in a full females and may be located within the abdomen or in its wall but never above the level of the umbilicus. The diversity of the sites in which they have been found is perhaps approached only by the number of theories of their origin.

*Embryonic theory.* As early as 1893 von Recklinghausen (35) discussed the subject of endometrial adenomata and suggested that they might arise from embryonic rests derived from the Wolffian body. But of this body have been described near the site for the inguinal canal in the embryo. This theory might therefore account for the endometrial adenomata of the round ligament but it would be difficult to attribute to the Wolffian body occupying a dorsal position in the embryo the production of endometrial tumors in the anterior abdominal wall of the adult.

Cullen (8) in 1914 suggested the possibility of remnants of Mueller's ducts as a point of origin. Again it would be difficult to account for endometrial tumors of the abdominal wall or the umbilicus on such a basis although it might be applicable to those of the rectovaginal septum or the broad ligament.

*Peritoneal theory.* Lockyer (17) in 1918 reported 47 cases of adenomyomata with endometrial glands in the rectovaginal septum and thought that the peritoneum or vagina was the source of the epithelium in most of these cases. Robert Meyer (10) believed them to be of inflammatory origin. Recently Nicholson (21) in a review of these tumors in laparotomy scars upheld the peritoneal theory.

*Displacement theory.* Cullen (6) in 1897 suggested that the adenomyomata of the uterus with glands of endometrial type were due to the invasion of the uterine wall by its mucous membrane. In 1911 Sampson (6) reported his first case of endometrial tissue in hemorrhagic cysts of the ovary which he held to be due to the implantation of endometrium escaping from the open ends of the fallopian tubes. Since that time an attempt has been made to account for most of the endometrial tumors on the implantation basis. Bonney (3) described a case in which endometrial tissue was accidentally implanted in the abdominal scar during a hysterotomy with curet-

tage. A typical endometrioma developed in the scar and was excised two years later.

Adenomyomata of the round ligament containing endometrial glands and stroma have been reported by Martin (19) von Recklinghausen (36) Cullen (5) Iffannestiel (3) Blumer (2) Weber (37) and Semmelink and de Josselin de Jon (33). Similar growths in the ovarian ligament have been reported (7). Lockyer (17) collected 47 cases occurring in the rectovaginal wall.

Cullen (5) reported an adenomyoma of the endometrial type occurring in the labium majus appearing 7 years after an instrumental delivery and becoming swollen and painful during menstruation. A similar growth was reported by von Recklinghausen (36) and one more recently by Henry (15).

Green (13) reported an adenoma of the umbilicus containing glandular elements of uterine character. Cullen (9) collected 11 such cases and Weller (38) has recently reported 2 more.

Ussell (25) demonstrated the presence of endometrial tissue in the ovary in 1899. This was confirmed by Casler (4) Cullen (10) and Norris (2). Since 1921 Sampson (26-28) has reported many such cases. Endometrial adenomata have been found in many locations in the abdominal cavity including the appendix (3).

The cases of adenomata of endometrial type occurring in laparotomy scars have been reviewed by Lemon and Mahle (16) Nicholson (21) and Pratt (4). The latter reviewed 46 cases up to 1916 and found that the age of occurrence varied from 0 to 46 with an average of about 35 years. Pain in the scar during menstruation was the most constant symptom and was present in 55 per cent of the cases. In 10 cases there was a definite connection between the tumor and the uterus. Local excision was sufficient to remove the growth in all but 2 cases but in these a second complete excision was successful.

The frequency of endometrial adenomata in laparotomy scars with relation to the operations by which they were preceded is shown in Table I.

Schwarz and Iallock (31) found endometrial adenomata in the abdominal scars of guinea pigs which had been subjected to cesarean section.

The cases of endometrial adenomata occurring in laparotomy scars after the opening of the



Fig 1 Photomicrograph Case 13 showing endometrial adenoma

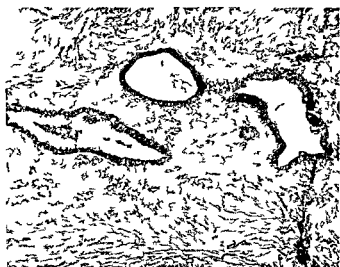


Fig 1 Photomicrograph Case 4 showing endometrial adenoma

pregnant uterus have been collected and new cases are added

CASE 1 Von Franque (34) reported the case of a woman who had had an operation 4 years previous for rupture of the uterus during abortion. When examined she had a tumor the size of a walnut in the abdominal scar but no symptoms referable to it. The tumor was removed and was found to contain typical endometrium.

CASE 2 T S Cullen (1) reported the case of a woman 34 years old who had a tear of the uterus ruptured during abortion 9 years previous. There was a tumor nodule in the abdominal scar 5 by 5 by 3 centimeters. This was removed and proved to be an adenomyoma of the rectus muscle.

CASES 3 and 4 J A Sampson (27) reported the case of F B Mallory of Boston. No clinical data was given but the two specimens were adenomata of the endometrial type found in the abdominal scar after caesarean section.

CASES 5 and 6 C I Burnham reported these cases for T S Cullen in the discussion of J A Sampson's paper (11). A case of J L Stavey of Washington and one of E A Cushman of Boston with adenomyomata in the abdominal scar following caesarean section.

CASE 7 J A Sampson (28) reported a case of Good and Mallory. A woman 3 years old had a caesarean section in 1903, a left salpingectomy in 1905 and a supra-umbilical hysterectomy in 1917. She noticed a small nodule in the abdominal scar a few weeks after the last operation. It gradually increased in size but was asymptomatic and was removed in 1922. It contained typical endometrial tissue.

CASE 8 N S Heaney (14) reported the case of a woman 32 years of age who had a caesarean section in 1921. One year later a sore lump appeared in the abdominal scar and was tender and extremely painful during menstruation. Two years later a nodule the size of a walnut was removed from the rectus fascia. It was hard and contained many blood-filled spaces. Microscopically it proved to be a typical endometrial adenoma.

CASE 9 N S Heaney (4) reported the case of a woman 38 years old who had a fetal operation and a 60-week ovum removed with a ruptured operation and a section of the uterine decidua. She soon noticed a tender swelling in the scar which became extremely painful and enlarged during menstruation. Three years later a nodule the size of a walnut was removed from the rectus

fascia on the first day of the menstrual period. It was found to contain many small hæmorrhagic cysts and microscopic examination revealed it to be an adenomyoma with typical endometrial glands in active menstruation.

CASE 10 W C Danforth (1) reported the case of a woman 20 years old who had a caesarean section and excision of the uterine ends of the tube for sterilization. She returned 10 years later with a tender hard mass in the scar which did not vary with the menstrual periods. It was excised and proved to be an endometrial adenoma.

CASE 11 O H Schwarz (3) reported a case for A Trumpe. A woman 28 years old had a caesarean section with an uneventful convalescence 3 years previous. Two years after the operation she complained of a sensitive spot at the upper end of the abdominal scar where a nodule the size of a cherry was found. The nodule was removed and microscopic study revealed the presence of endometrial tissue.

CASE 12 C B Kelevy (1) reported the case of a woman 30 years of age who had a caesarean section in 1920. Three years later a small lump appeared at the lower end of the abdominal scar. The tumor gradually increased in size and was especially painful during the menstrual period. When the patient was examined in 1925 the tumor was 1 inch in diameter, freely movable on the deep fascia and tender while the skin over it was adherent and pigmented. On removal the tumor was found to have no connection with the uterus or peritoneum. Microscopically it proved to be an endometrial adenoma.

The following cases are from the Surgical Service of the Peter Bent Brigham Hospital, Boston.

CASE 3 A woman 28 years of age gave a history of having been subjected to a caesarean section on 4 years

TABLE I

Operation	C	P	tg
Ventrofixation of uterus	8	37	
Opening of the pregnant uterus		3	
Pelvic operations (alpingectomy, oophorectomy)	10	20	
Support of the uterus	5	10	
Appendectomy	3	6	
Hysterectomy	1		
Total (8 months)	40	86	
Caesarean	1		



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## SUMMARY AND CONCLUSION

Endometrial a leiomyoma in the abdominal scar following opening of the pregnant uterus have been reported in 12 cases. These cases are here reviewed and new cases are added.

The most frequent symptom is pain in the scar during the menstrual period. Local excision is sufficient for removal of the tumor.

The implantation theory would seem to give the best explanation of the origin of this group of endometrial adenomyoma.

The occurrence following cesarean section would suggest the use of the low type of uterine incision as the lining is chiefly cervical mucosa in that region.

## BIBLIOGRAPHY

- B ( J O l t & C B t E m p 9 6  
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- 3 B \ E V \ J O l t & G y e B t E m p 9 6  
 4 C S L R D B T r A m C y n S 9 1 9 x d 6 9  
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## CONTROLLABLE SPINAL ANÆSTHESIA IN OBSTETRICS

By GEORGE P. PITKIN, M.D., F.A.C.S. AND FRANK C. McCORMACK, M.D., TRENECK, NEW JERSEY  
 Th H y N m H p t l

AMERICAN medical literature does not contain a description of any technique whereby anæsthetic agents may be introduced into the subarachnoid space of the lumbar spine so as to produce caudal anæsthesia. Furthermore a careful search of the literature fails to reveal that gladin has ever been used to prevent dissemination of anæsthetic agents in spinal fluid thereby controlling the extent of anæsthesia on the body surface.

In our experiments with controllable spinal anæsthesia it has been definitely demonstrated that if 2 cubic centimeters of anæsthetic solution are injected into the subarachnoid space anæsthesia will extend upward in the canal to and including the third and fourth lumbar nerves. In small spines it may extend as high as the second lumbar interspace but if the amount of solution is decreased without a change in the amount of novocain it becomes possible to confine the anæsthetic to the lower portion of the spinal canal so that only the sacral nerves become anæsthetized (19) producing anæsthesia limited to the perineum a typical saddle anæsthesia which is limited in front by the symphysis and in back extends over the lower part of the sacrum and down the inner side of the thighs for 5 or 6 inches. There is no impairment of motion or anæsthesia of the legs. The technique of limited spinal anæsthesia has been employed in 273 gynecological and rectal cases without any deviation a typical caudal anæsthesia produced intradurally. The method of confining spinal anæsthesia to the legs and controlling its height on the body surface has been described in detail (18). Therefore it would seem that the number of successful cases has been sufficient to justify mention of this particular form of technique.

In female patients the cervix vagina perineum vulva and sphincters of the anus and bladder are completely anæsthetized while sensation of the uterus is not impaired. The cervix can be dilated without pain but curettement of the fundus is painful.

Realizing the possibility of these results in obstetrics we prevailed upon the Obstetrical Department to permit the use of this form of limited spinal anæsthesia in their difficult cases. The results were so satisfactory in 89 cases of instrumental deliveries versions breech cases

and prolonged labors that it seems worth while to report the findings and the deductions which have been made.

After the first two deliveries with the patient in a Trendelenburg position the impracticability of a solution of light specific gravity was apparent and glucose was substituted for the alcohol in the controllable spinal anæsthetic preparation (18) and a 40 per cent instead of a 10 per cent novocain solution employed. This permitted the same limited anæsthesia and allowed the patient to repose comfortably in a semi reclining position throughout delivery.

The technique of controlling the anæsthetic solution and limiting its contact to those strands of the cauda equina that pierce the tip of the dural sac forming the sacral nerves (Fig. 14) is relatively simple with the use of gladin (the mucilaginous content of wheat starch) which prevents dissemination or mixing of the anæsthetic solution with the spinal fluid until the anæsthetic agent has been absorbed. Too much gladin in the solution eliminates all anæsthetic properties or greatly delays anæsthesia. Too little gladin causes the solution to be devoid of all controllable features. The gladin also has much to do with the lessening of the toxic symptoms of the novocain. With this preparation 200 or even 400 milligrams (21) of novocain may be employed and will give less reaction than when 100 milligrams are dissolved in the spinal fluid and re-injected.

The technique employed in the use of this solution varies somewhat from other forms of spinal anæsthesia. When deviations from the ordinary routine of other methods of spinal anæsthesia are employed an explanation will be made.

When local conduction or spinal anæsthesia is used the paramount issue at all times is never to hurt the patient in any way at any time. A patient once hurt may lose confidence in the method and in the doctor. A confidence once lost may be very hard to regain and many times constitutes the direct cause of unsuccessful anæsthesias. A patient that is immediately subjected to one painful manipulation becomes over apprehensive of every following procedure. In spinal anæsthesia with novocain it must be remembered that tactile sensation is not abolished.



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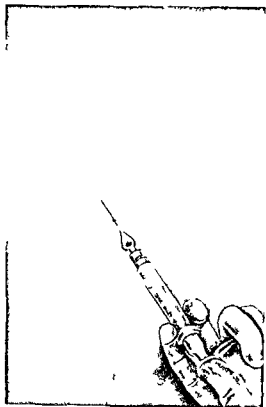
All the more reason why every precaution should be taken and the technique employed with such finesse that spinal anesthesia may be administered without producing any pain. With an



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entirely satisfactory anesthesia the patient should be at ease, comfortable and cheerful throughout delivery.

To perform the lumbar puncture raise the head of the delivery table from 15 to 20 degrees (Fig 11). This degree of elevation is hard to judge but is readily measured by the use of the tiltometer. The patient is then in a slightly reverse Trendelenburg position and should be kept so throughout the course of delivery. If for any reason this is impossible she may be placed nearly flat but not until after the anesthesia has become fixed, namely from 12 to 15 minutes. If an adjustable delivery table is not available pillows may be employed to secure a similar position (Fig 12).



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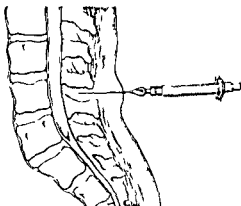


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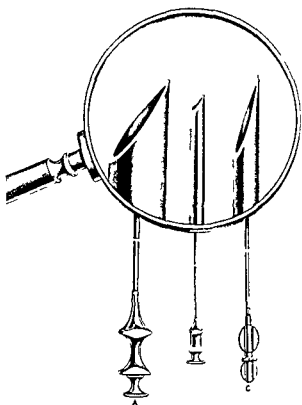


Fig 5 Compare the size of needle A with B. Also compare the taper of needle C with that of needle B the author's spinal puncture needle

The patient should be turned on her side preferably the right. The knees should be flexed upon the abdomen, the head bent forward so that the chin rests on the chest and the back bowed out (Fig 1). The shoulders and hips should be in a vertical line. If the shoulders are tilted and the hips remain vertical or if the hips are tilted and the shoulders perpendicular a cork screw spine will be produced and may present difficulty at the time of puncture. A scaphoid back should be avoided as this causes the spinous processes of the vertebrae to overlap and makes puncture difficult and painful. If the physician is unfamiliar with the technique of this position the patient may be permitted to sit on the edge of the delivery table with the feet hanging over the side, the body bent forward, the elbows resting on the knees and the back bowed outward (Fig 2). She may be permitted to remain in this position for from 10 to 15 minutes until anaesthesia becomes fixed or may immediately be placed in a semi-reclining position with the head of the table elevated as already described. However in the sitting position the patient's comfort and ease is disturbed. Never permit the patient to lie

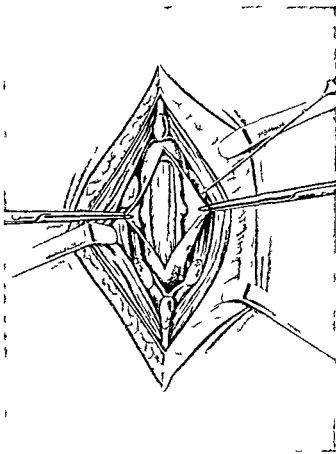


Fig 6 Illustrating the minute trap door cut in the dura made with the author's needle

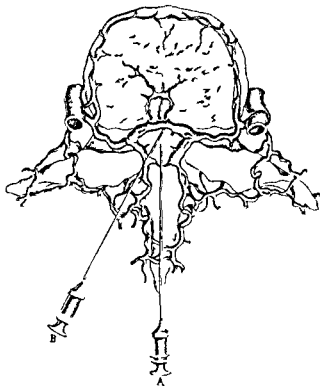


Fig 7 A The correct way to make a spinal puncture B the incorrect way. Note the extensive venous supply

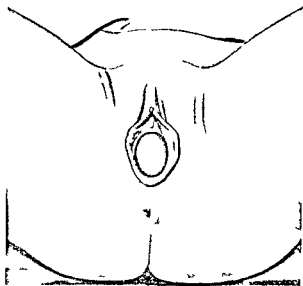


Fig 8 The lumbar puncture site is indicated by a small circle on the left side of the lower back, between the fourth and fifth lumbar vertebrae.

entirely flat or in a Trendelenburg position (2) when the heavy solution is used as there is danger that the solution may ascend high in the canal and produce a drop in blood pressure, nausea, vomiting and headaches.

The skin from the eighth dorsal to the lower part of the sacrum is painted over an area 5 or 6 inches wide with a 3 per cent tincture of iodine. If for any reason iodine is contra indicated 5 per cent mercuric bichloride may be substituted. The logical site to introduce the spinal puncture needle for this particular form of anesthesia would be the lumbosacral interspace so as to introduce the anesthetic solution directly at the site of contact but unfortunately in a number of cases we have found that the dural sac terminates above this interspace therefore the fourth interspace is selected as the site of puncture. This may easily be determined by palpating the spinous processes along an imaginary line drawn between the crests of the ilia. When the interspace between the fourth and fifth lumbar vertebrae has been determined it may be marked by firm pressure with the thumb nail of the gloved hand. At this site a cutaneous wheal is raised with 0.65 cubic centimeter solution of novocain 0.03, ephedrine 0.5 and normal saline q.s.

A fine 25 or 27 gauge hypodermic needle is used (Fig 5). The needle is not withdrawn but is carried directly into the interspinous ligament (3) and the other 0.65 cubic centimeter of the

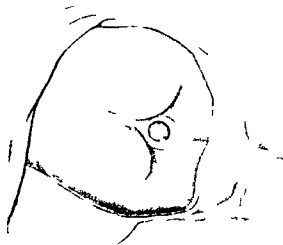


Fig 9 The head is tilted back and the neck is extended.

solution injected as the needle advances. One should endeavor to inject the solution a little faster than the needle proceeds so that the needle is introduced into a freshly anesthetized area (11-14). To avoid the unpleasantness of having to dig out a broken needle it is advisable to have the needle equipped with a safety guard similar to the one shown in the drawings.

Spinal puncture is made through the center of the wheel raised with the novocain-ephedrine solution with a fine 22 gauge lumbar puncture needle. The needle should have a short bevel of 45 degrees (Fig 5 B) as in the author's spinal puncture needle. The rear part of the bevel is rounded in such a manner that it has no cutting surface while the reverse side of the point is ground so as to produce a spear point. When this needle pierces the dura it cuts a miniature trap door (18) which is closed by the intradural pressure when the needle is withdrawn (Fig 6). The spear point of the tip permits easy penetration of the skin and tissues. For many reasons rustless steel needles are superior to nickel or nickel plated ones. The point remains sharp longer than that of the ordinary needle. There is no nickel plating to peel off. The needle will not tarnish, become rough or pit; it will not rust on the inside nor break unexpectedly and it is tempered so that it will stand extreme bending and manipulation without breaking. In every case the stylet should be removed and the needle bent into a semi circle before it is sterilized. This testing may prevent the unpleasantness of removing a broken needle from the interspinous ligament.

Avoid using a needle of large caliber such as the old Bier 15 to 17 gauge needle (Fig 5 1).

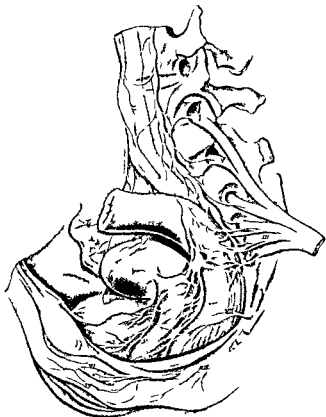


Fig 10 The nerves to the 1 fundus of the uterus 2 ovary 3 bladder 4 tube 5 branches of the hypogastric plexus and 6 the sympathetic are not anesthetized. The following are anesthetized I the pudendal plexus II and the cervical vaginal and vesical nerves III perineal IV cutaneous V posterior nerve of the clitoris VI labial VII middle hemorrhoidal VIII inferior hemorrhoidal and sphincter ani from the sacral plexus. The fourth and fifth lumbar (L IV and L V) and the first sacral (S I) are sometimes anesthetized.

which will not only cause unnecessary pain when it is introduced but will traumatize the tissues and often produce postanæsthetic backache. A large needle may produce intradural hæmorrhage or it may injure or cut the cauda and permit seepage of spinal fluid into the extradural tissues because of the large hole left in the dura. Long tapered (Fig 5 C) needles produce bleeding more frequently at the time of puncture. With their use anæsthesia is frequently unsatisfactory because a part of the taper is within the dura and the remainder outside or a part of the taper is within a vein and the remainder in the dural sac. Should only a part of the taper be within the dura some of the solution is deposited extradurally. Anæsthesia will be unsatisfactory or incomplete. Should part of the taper be within a vein when the solution is injected convulsions may ensue. With a short tapered needle as shown these undesirable complications rarely occur. When

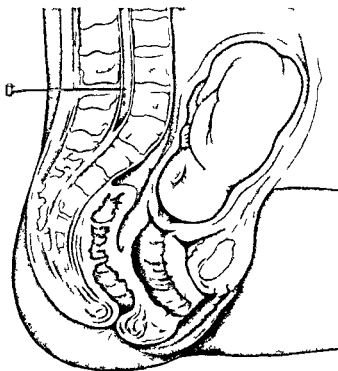
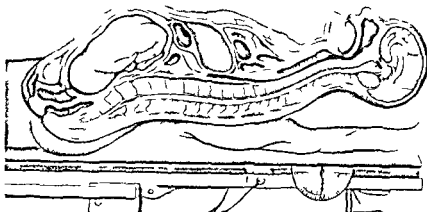


Fig 11 When the anæsthetic solution is introduced into the subarachnoid space it gravitates to the extreme tip of the dura and produces anæsthesia of the tissues as shown by the shaded area.

the puncture is made through the interspinous ligament care should be taken not to deviate to the right or left. The puncture should be at right angles to the long axis of the spine. Never attempt a puncture between the laminae (Fig 7 B). Avoid inserting the needle in an upward direction or at an acute angle to the spine. The veins about the cord are large and numerous but may be avoided and not penetrated if the spinal puncture is made in the manner described (Figs 7 A and 11). Unnecessary bleeding will surely be produced should the puncture be attempted between the laminae with the needle tilted with a needle of large caliber or with a long tapered point.

When the dura is punctured there is a slight snap which is recognized after the first few punctures and the needle advances with less resistance. If possible avoid piercing the opposite side of the dura with the point of the needle or coming in contact with the body of the vertebra because this also will cause bleeding (Fig 7 B). With the assurance that the dura has been entered the stylet is removed and spinal fluid should flow through the needle. If no spinal fluid appears rotate the needle on its own axis. If there is still no spinal fluid insert the needle deeper. If bony resistance is felt (the body of the

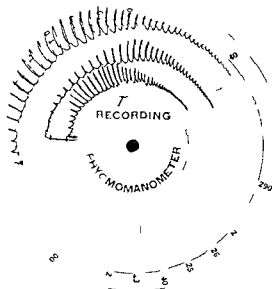


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vertebra) the needle has undoubtedly deviated to one side. It should be withdrawn to the skin surface and reinserted at a slightly different angle to the right or left as the case may be. Always have the stylet in place when making manipulations. Occasionally the first drop or two of spinal fluid will contain blood. If this clears the injection may be made. If not the needle should be withdrawn and re-introduced. The injection of the anæsthetic solution should never be made until clear spinal fluid flows through the needle which is the only assurance

that the point of the needle is within the dural sac. Unless the solution is injected into the sub-arachnoid space anæsthesia will not be satisfactory.

It is advisable to fill both hypodermic syringes with the respective solutions before spinal puncture is started. The filled syringes and needles should be placed in a convenient position to the operator before the procedure is started. Attach the syringe with the solution containing novocain 2, gladin solution 13, strychnine sulphate .00, glucose .065 and normal saline q.s. 5 to the spinal puncture needle. Aspirate one or two drops of spinal fluid to make sure that the needle has not been displaced, then slowly inject the contents of the syringe. Do not again aspirate or in any way attempt to mix the solution with



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the spinal fluid. Withdraw the needle and cover the puncture wound with collodion or a small square of adhesive plaster. Turn the patient on her back. Anæsthesia will be complete as soon as the patient can be prepared and draped. This procedure limits the contact of the solution to the lower tip of the dural sac and causes anæsthesia of the perineum only (Fig. 8).

It is better to have a syringe with a secure locking device to insure a tight fit to the needle (Fig. 3) thus preventing the possibility of injecting air into the dural sac or leakage at the connection. With a locking device on the syringe the needle may be manipulated if necessary and if the patient moves there is little chance that the syringe will be disconnected from the needle and some of the anæsthetic solution lost. With the locking device employed needles never become jammed and there is no locking at the connection.

The semi reclining or reverse Trendelenburg position of from 15 to 20 degrees should be maintained for 1½ to 2 hours after injection so as to avoid the possibility of having the anæsthetic ascend in the canal also by retaining the anæsthetic low in the dural sac. Headaches will be greatly diminished. If for any reason anæsthesia is desired higher on the body surface it can be obtained by mixing the solution with spinal fluid. This is done by aspirating and re-injecting

4 or 6 cubic centimeters of the spinal fluid. Four cubic centimeters aspirated and re-injected will produce anæsthesia of the legs. Six cubic centimeters will carry anæsthesia to the umbilicus and 8 cubic centimeters to the costal margin. For the higher anæsthesia the viscous alcohol solution is preferable as this will permit the patient to be placed in a level or Trendelenburg position. The heavy solution should never be used when the head is to be lowered.

Pre-operative narcotics are not necessary in this form of anæsthesia. The relief of pain afforded the mother allays all fear and apprehension. Morphine and scopolamine if used may possibly so affect the child that strenuous resuscitation methods will be necessary. The mother may remain in a dorsal recumbent position or may be placed in stirrups without effecting the limitation of the anæsthesia provided the body is kept in a reverse Trendelenburg of from 15 to 20 degrees.

Many advantages of controllable spinal anæsthesia were found in a study of 3724 cases of general surgery including 68 cesarean sections and 89 obstetrical cases as compared with various forms of inhalation anæsthesia. The apparatus required for the introduction of this anæsthesia

is comparatively inexpensive and may be found in almost every physician's outfit. Two (2) cubic centimeter hypodermic syringes, one hypodermic needle, one spinal puncture needle and the anæsthetic solution.

The technique is very simple. No greater knowledge is required than that of doing an ordinary diagnostic lumbar puncture. The details of which are familiar to every physician. Should there be any doubt as to the simplicity of the procedure 10 minutes practice on the cradler will familiarize any physician with the ease with which a lumbar puncture may be made in the fourth interspace.

A limited spinal anæsthesia may be administered by the operator himself thereby eliminating the necessity of an anæsthetist or an assistant. This would appear to be a very great advantage in emergencies in isolated or country practice or in small hospitals without internes.

The anæsthesia is quickly secured in from 1 to 3 minutes after injection. It becomes fixed within from 10 to 12 minutes. Satisfactory and complete anæsthesia occurs in over 99 per cent of cases. On account of the ease of introduction and rapidity of action it is better than sacral or caudal anæsthesia (17) which is invariably delayed from 15 to 25 minutes after injection. Caudal anæsthesia is estimated to be unsatisfactory or incomplete in from 15 to 5 per cent of cases. The injection of the hiatus requires considerable skill and practice. The same may be said of parasacral anæsthesia. To say nothing of the pain frequently caused as a result of inexperience or awkwardness.

The safety of an intradural sacral anæsthesia is much greater than ordinary spinal anæsthesia and may be conservatively estimated as being as safe as caudal anæsthesia. The mother suffers no shock or drop in blood pressure (Fig. 13). There is no danger of suffocation, cyanosis, strangulations or swallowing of the tongue or false teeth as with inhalation anæsthesia. The child is better protected than with any other form of anæsthesia. Asphyxiation or cyanosis of the child is rare. The effects of morphine, scopolamine, ether, chloroform, various other narcotics and anæsthetics are unquestionably transmitted to the child and at times make resuscitation difficult. A distinct advantage is that the anæsthesia may be confined to the perineum or carried to any desired height on the body surface by expanding the solution as described in the technique. It also eliminates postanæsthetic complications. Due to its limited field of contact intradurally (Fig. 11) it does not produce the after effects encountered with stovaine or neocaine spinal





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3	P g n y t t b c u			4 th l mb	oo	5	T h p t b o	o-8	40-96	4	h	U m b l	N	N m k j l l g b d f l f t t t t t b
7	I m p l t b o t			4 th l mb		5	D l t t t t g	o-8	30-8	5	j h	S y m p h y	N	T h t h t p f t h t h b l T h l e r f t h p h t l m
DR SIMON D EHRLECH FLOWER HOSPITAL ST MARK'S HOSPITAL AND BETH ISRAEL HOSPITAL NEW YORK														
4	T b e n o s	f l f i d d y		t h d l	oo	5	N p h t m y	o-8	40-8	5	h 4 m u	q t h b	N	S y t l m m R a l p p h t l b
48	H m r r h d s			3 d l m b	oo	5	H m h d t m y	o-8-60	8-60	3	h r	y m p h y	N	P t t t b f good t y R g d p
8	Ch m t t p p d d doc r v t u s			d l mb	oo	5	A p p d t m y d t t g m p t t t x	o-80	4-7	4	h +	C l m g	N	A p p h g I t p t
4	H e m h d d f t l			i d 3 d l mb	5	5	H e m h d f f t l t t t	8-6	8-6		h +	U m b l	N	h a x t h t b l d f h t t m A x t l g d
9	O p p d t			d l mb	5	5	R t d p f p d t m y	5-9	o-8	6	h +	C t l m g	N	G C l f d t g d
DR MEREDITH F CAMPBELL UROLOGICAL SERVICE BELLEVUE HO PITAL NEW YORK														
	C k u l	l e t		d l mb	oo	5	U t t m y	4-68	5	68	4	h 4 m	N	U r l t l t y C m
55	S t t f t h y t t			4 th l m b a r	oo	5	E t l d t h t m y	40-9	35-8	3	h 4 m	S y m p h y	N	S t t t m d f t m t l d l b g N t
48	R l k u l			d l mb	oo	5	P y l t m y	o-8	o-63	5	h r +	q t h b	N	C t t t f t t t h f t f d m y t t b b
4	S t	p p t		t l mb	oo	oo	U t t m y	-64	78	5	h r +	q t h b	N	t t
78	C a m f l u d d			t l mb	oo	5	C p p b t t t m f l b l d d t m d m m r l t t	o-85	6-96	5	h 3 m	U m b l	N	S m m f t h d d g p t O p t t

anæsthesia such as vomiting and headache (13) It does not affect the heart as does chloroform and has no effect upon the kidneys or liver as has ether ( ) Postoperative lung and intestinal complications are reduced to a minimum

Dehydration is not produced with this form of anæsthesia (10) A distinct advantage in cases of eclampsia and toxæmia is that water or liquid may be given freely before during and after delivery

It assures the co-operation of the patient throughout delivery which is a great help when it becomes necessary to change the patient's position particularly when assistants are unavailable The patient is able to bear down and aid in delivery

It may be given to patients with bronchitis or influenza without harm Cardiac nephritis alcoholics addicts or patients suffering with primary or pernicious anemia take this form of anæsthesia much better than inhalation Hypertension or hypotension is not affected Regulation of the amount of ephedrine controls the blood pressure

Shock is eliminated (11) The reflexes are blocked Severe and prolonged cases are carried through with little if any change of condition There is no unpleasant postpartum reaction

Vomiting during or after delivery is a rare occurrence This may be accounted for by the fact that the blood pressure is not affected and the splanchnics are not anæsthetized

Distention or ileus does not occur as with inhalation anæsthesia The sphincters are relaxed peristalsis is stimulated—a distinct advantage especially for the patient's comfort

It increases the patient's comfort during and after delivery There is no lowering of her resistance Nourishment may be taken immediately after delivery (3)

The blood pressure is not affected This is a distinct advantage over other forms of spinal anæsthesia which cannot be administered in severe cases of hypotension It has been used with success in cases in which the systolic pressure was 78 without change throughout the procedure

Postpartum hemorrhages are less frequent The uterus contracts quickly and firmly after delivery Pituitrin may be used without fear The anæsthetized cervix offers little or no resistance to the advancing head

The cervix and perineum are protected to a greater extent from trauma and lacerations The amount of relaxation and elasticity of these parts when anæsthetized is amazing

Cystocæles are not apt to be a postpartum complication The bladder spontaneously empties during delivery because the sphincter is anæsthetized

Vaginal cæsareans may be eliminated The cervix readily dilates or may be dilated manually with ease

The mortality and morbidity of obstetrical cases are reduced because shock to the mother and postpartum anæsthetic complications do not occur The child is offered greater protection because there is less trauma in forcible deliveries as a result of the relaxation of the soft parts and because there is no absorption of toxins from narcotics or inhalation anæsthetics

The disadvantages of intradural sacral anæsthesia in obstetrics appear to be few and of little consequence The so-called dry taps may be advanced as a disadvantage It is doubtful if such a condition really exists and may be attributed more to inexperience than to any pathological condition Possible injury to the cauda equina may be considered When such a complication exists it is not infrequently traceable to a bungling technique or the use of large spinal puncture needles

Perhaps one of the greatest disadvantages that can be attributed to this form of anæsthesia is its duration which is from 90 to 120 minutes Should the duration of the delivery exceed the time of the anæsthesia there is no reason why a second injection should not be given The duration of a second injection of the anæsthesia is invariably longer than the first 2 to 3 hours

It is hoped that our intentions will not be misinterpreted or misconstrued We do not wish to imply that this is the ideal and only form of anæsthesia to be employed in obstetrics It is offered as being simpler quicker and more efficient than caudal or sacral anæsthesia and as a method of relieving pain suffering and misery in those unfortunate cases in which various forms of inhalation anæsthesia would be detrimental to mother or child or both

The indications in obstetrics for limited spinal anæsthesia in preference to inhalation anæsthesia are so logical and well founded that if the patient's welfare is to be considered a working knowledge of this form of anæsthesia should be possessed by all obstetricians so that the dangers of inhalation anæsthesia in certain obstetrical cases may be avoided and many useful lives saved

There appears to be no well grounded or sound reason why inhalation anæsthesia should be used in tuberculosis (6) acute chronic or arrested cases In acute tuberculosis the condi-

tion is invariably made worse to say nothing of the numerous pulmonary complications that may develop. Not infrequently the chronic or arrested case is converted into an active case. To administer any form of inhalation anæsthesia to a patient suffering with acute or chronic bronchitis is to run the risk of fatal pneumonia.

Patients suffering with asthma or emphysema appear to be greatly relieved with the administration of spinal anæsthesia. Perhaps this is due in part or almost wholly to the effect of the epheдрine. At any rate the after effects of inhalation anæsthesia should always be borne in mind in this particular class of cases.

In cardiac conditions with decompensated hearts the cyanosis produced by the efforts of labor pains is relieved at once. Dyspnoea is lessened and the patient's condition relieved instantly. If apnoea is present the patient is able to assume a reclining position without discomfort. High spinal anæsthesia relieves these conditions entirely.

In cases of eclampsia (24) and toxæmias of pregnancy the kidneys are not affected as with ether. Suppression does not occur and elimination is not affected. The patient is not dehydrated. There is no primary withholding of fluids at the time of delivery or secondary loss by vomiting as a result of inhalation anæsthesia.

The acidosis (12) which is invariably present in this type of case is not increased but is often lessened because of the increased peristalsis and relaxation of the sphincters. Any form of inhalation anæsthesia however will increase acidosis and should never be given when acetone or diacetic acid is present in the urine.

The renal elimination in nephritics (1) without eclamptic symptoms is not affected with spinal or sacral anæsthesia. It might be said that chloroform could be used with safety but we must not forget the cloudy swelling and fatty degeneration of the liver and kidneys and the effects thereof 4 or 5 days postpartum. Some will say that nitrous oxide or ethylene could be used without harm. Our experiments on animals invariably show that with these forms of anæsthesia hæmorrhage in the glomeruli is produced.

If pyelitis or pyelonephritis occurs at the time of labor or if either has recently been present the patient should not be subjected to the harmful possibilities of inhalation anæsthesia. In fully 50 per cent of the cases in which pyelitis or pyelonephritis is dormant or has subsided it will recur following general narcosis.

Severe cases of hypertension call for this form of anæsthesia and not infrequently do we see a

permanent drop of from 10 to 20 points after its use. By carrying the anæsthetic higher in the canal a greater drop can be obtained if desired.

Diabetes is a serious complication at best and one not easily dealt with. Spinal or sacral anæsthesia would appear to be the only safeguard in these cases.

In the anæmias of pregnancy either primary or pernicious better results are obtained with spinal anæsthesia. There is less hæmorrhage at the time of delivery, no vomiting or dehydration and the blood chemistry is not changed.

The patient with a short fat neck takes inhalation anæsthesia badly but does not seem to mind spinal anæsthesia. On patients suffering with goiter (5) exophthalmic or toxic adenoma spinal or local anæsthesia has little effect provided adrenalin is not used. They invariably take inhalation anæsthesia badly and cardiac complications may cause it to be absolutely contraindicated.

In cases of severe shock due to long tedious labor in which delivery has been attempted at home without success and the patient has then been brought to the hospital spinal anæsthesia may be successfully used. These patients greatly improve by the judicious and free use of epheдрine.

In prolonged and difficult labor (23) in which the physician has reason to believe that delivery will take place without instrumental interference a rest period from pain may be produced with spinal anæsthesia and the patient permitted to regain some of her strength. Not infrequently the relaxation of the soft parts favors quick easy delivery.

An example of this may be shown in a primipara 3 hours in labor with the cervix dilated 3 fingers. A limited spinal anæsthesia was given the cervix became soft and completely dilated within 20 minutes and offered little or no resistance to the oncoming head. The child was delivered 48 minutes after the subarachnoid injection and the mother was perfectly at ease. She suffered no pain and smiled as the head advanced over the perineum.

The rigid or spasmodic cervix is little affected with inhalation anæsthesia. With spinal anæsthesia the cervix quickly becomes soft and flabby and offers little or no resistance to the oncoming parts or is easily dilated by manual efforts. The so-called Bandl's ring or hour glass contraction is not relieved with a limited spinal anæsthesia. If such a condition exists it will be necessary to carry the anæsthetic high enough in the spinal canal to anesthetize the hypogastric plexus or

to the ninth dorsal vertebra. If this is done the spasm and contraction are relieved much more readily than with inhalation anesthesia. Cases of cesarean section ruptured uteri or ruptured ectopics call for this form of anesthesia not only for the greater protection it offers the mother and child but because it eliminates to a great extent postoperative distention or ileus. The surgeon has better working conditions. There is less trauma to the abdominal wall, no handling of intestines, less bleeding and a shorter convalescence.

Forceps are apparently applied with greater ease and extraction is accomplished with less effort. The amount of relaxation and elasticity in the anesthetized perineum is almost incredible. If the cervix is not fully dilated it may be manually dilated with little or no effort. The co-operation of the mother and normal uterine contractions assist materially in the delivery. There is less trauma to the child and lacerations are less apt to occur. When Killands are used in retropositions and the position is corrected delivery may take place without further instrumental aid.

Versin may be performed with greater ease. The relaxed soft parts permit the insertion of large hand without any difficulty. There is no shock to the mother. Tetanic contractions may be relieved by carrying the anesthetic higher as already explained.

In breech presentation (15) specially in old or young primiparae the fate of the child is better. Broken arms and legs are less apt to result and delivery can be performed with less effort.

We wish to emphasize the softness and lack of resistance of the cervix and the extreme elasticity of the perineum (19) because it is almost inconceivable until it is witnessed. Slight digital pressure upon the posterior fundus of the vaginal wall permit dilatation four or five times the normal size. Titulation may be used safely if it is given 10 minutes after the spinal anesthetic provided obstetrical judgment is used.

The only contraindication that would apply to this form of anesthesia would seem to be normal delivery in multiparae because these cases usually may be carried through comfortably without deep narcosis.

The question still naturally arises as to whether a 40 per cent novocain solution introduced into the subarachnoid space will cause irritation. This does not occur. Before this solution was used in humans 6 dogs were injected and secondary taps made 6 hours later. The cell count was no greater than when a 10 per cent novocain solu-

tion was used. In fact fewer cells were observed than when a 5 per cent cocain or stovaine solution was introduced into the dural sac. The lack of intradural irritation may be attributed to the fact that the solution remains in a small and dependent portion of the dural sac. Its contact is limited to not more than 1 inch of the extreme tip of the canal as shown by X rays (Fig. 14) or the lack of irritation may be explained in that novocain itself is not irritating to delicate membranes. The instillation of pure novocain crystals on the human cornea was found to produce little or no irritation. Powdered novocain was applied to the corner of animals 6 times in one day and no visible inflammatory reaction was produced. The postanesthetic aspects of the patient have been no different than when a 10 per cent solution was used. Risacher and Waitz have used a 50 per cent solution with no deleterious results.

Since the introduction of starch paste as a controllable feature in spinal anesthesia several inquiries as to the solubility of starch or gladin have been received and likewise as to whether or not the gladin might act as a foreign body. This can be answered in the negative. Gladin is extracted from wheat starch through triple 500 mesh silk and rendered soluble before it is added to the anesthetic solution. A detailed description of the technique of rendering it soluble and the method employed to prevent fermentation would be too long to include in the present paper. When the starch paste was used before gladin was employed there were frequent variations in the viscosity of the solution and suspension could not be maintained for more than 10 minutes. With gladin we are now able to prevent dissemination in the spinal fluid for over 48 hours. The amount of viscosity is constant and reliable and there is no tendency to variation. The solution will not ferment as sometimes happens with the starch paste. It appears to be permanent and may be kept for at least 1 year without deterioration. We do not know how much longer it can be kept.

The blood pressure is not affected because none of the vasomotor constrictors are anesthetized. The vasomotors are thrown out from the cord with the spinal nerves from the second dorsal to and including the first lumbar and to those familiar with spinal anesthesia it is well known that the blood pressure drops in direct ratio to the intensity plus the number of vasomotor constrictors anesthetized. Stovaine causes the greatest reaction, novocain the least. With controllable spinal anesthesia we are able to limit

the upward extent of the solution to any desired height in the spinal canal by regulating the degree of the Trendelenburg position employed as measured by the tiltometer plus the amount of the expansion of the solution which is obtained by mixing it with the spinal fluid. Four cubic centimeters of spinal fluid mixed with a solution will anesthetize the lumbar nerves and produce anesthesia of the perineum and legs 6 cubic centimeters to the tenth dorsal segment anesthetizing the abdomen to the umbilicus. Eight cubic centimeters will carry the solution to the seventh dorsal segment producing anesthesia to the costal margin the highest anesthesia required for abdominal work only anesthetizing half of the vasomotor constrictors. Ephedrine employed in an amount proportionate to the height of anesthesia will stabilize the blood pressure. In sacral anesthesia no ephedrine is necessary and it is only used as a safe guard in case the patient should assume a position permitting the anesthesia to extend upward. When anesthesia of the lumbar nerves 30 milligrams to the tenth dorsal 50 milligrams and to the sixth or seventh dorsal 65 milligrams will at all times absolutely stabilize the blood pressure.

Ephedrine is superior to suprarenalin in maintaining the blood pressure because its duration may be depended upon for 2 or 3 hours or until the anesthetic has become absorbed and eliminated whereas the effects of suprarenalin on the vasomotors will not last more than from 15 to 20 minutes and must then be repeated.

The dreaded drop in blood pressure does not occur (o). Dry wounds are not observed. There is as much bleeding as with inhalation anesthesia. Respiratory and cardiac embarrassment does not occur. During delivery it is not necessary to administer stimulants. Saline tears are eliminated. If the technique as to the position of the patient the amount of expansion of the fluid and the use of ephedrine is observed the patient may be carried through without the slightest drop in blood pressure (Fig. 13). Not infrequently does the blood pressure rise 10, 20 or 30 points.

Braun says that suprarenalin made local anesthesia possible. That being so ephedrine has contributed much to the safety of spinal anesthesia (16). When the blood pressure is maintained pallor and cold sweats do not occur. Nausea and vomiting are either greatly diminished or eliminated. These facts alone make the operator more at ease and the patient much more comfortable. One author graphically states that the blood settles to the dependent parts of the body

when spinal anesthesia is used and that the radial pulse has no clinical significance because of the relaxed condition of the arterioles and because the impulse of the heart beat is not carried to the wrist (14). In other words the patient is pulseless. If Babcock (3) or Boyd (4) who together have administered spinal anesthetics 47,000 times saw a patient in a pulseless condition they would be greatly alarmed. To the inexperienced or to the one using spinal anesthesia for the first time it would undoubtedly give such a fright that he would permanently abandon it.

A report of several cases of controllable spinal anesthesia by operators in various parts of the country unknown to each other and many of them personally unknown to the authors who have used this form of anesthesia independently would seem to be more convincing than words. Table I deals only with the heretofore dreaded complications of spinal anesthesia.

#### SUMMARY

In conclusion we do not wish to insinuate that spinal conduction or local anesthesia should always be employed but past experiences have taught us that with their use we do not encounter the troublesome postoperative anesthetic after effects such as nausea vomiting gas distention ileus acidosis pneumonia and innumerable other complications which are directly caused by inhalation anesthesia. The primary mortality is undoubtedly less whereas the secondary mortality (8) or in other words the mortalities that occur from one day to one week following operation and which are due directly to inhalation narcosis are practically nil. Morbidity is reduced to a minimum. Since spinal anesthesia has been developed to the point of safety which it now enjoys the technique of induction has been so perfected that with these anesthetics we are able to perform any operation upon the human body with greater facility and offer better protection to the patient. Today patients are not to be classed with those of a decade ago. They have been educated and enlightened not only as to anesthetics but as to obstetrics surgery and medical procedures in general through public health movements societies and the press. Their knowledge must be respected. Therefore we should perfect ourselves in the technique of spinal conduction and local anesthesia so as to be able to meet the demands of the public.

For the development of this anesthesia in the future we will have to look chiefly to the younger men. Twenty years ago spinal and local anesthetics were rarely used. Today they are rather

popular and are being more and more generally used. Spinal conduction and local anesthesia will undoubtedly increase in popularity in the next 10 years.

## BIBLIOGRAPHY

1. J. L. CRISTOL, P. nd BONNET, V. A. 25  
the ia d ac d i J durol 9 5 5  
Ab t ct d n J Am M A 9 100 1 00
3. KRO N W L m! an the a nd gynec 1 m 1  
lapa tomes Zent abli f Gyn ek 1925 21  
636 7
4. L. AT GASTON Cr ulato d tub es sso ated  
th ubaraci id blo k Lon Isla dM J 927  
573 79
5. L. TEJOU Sp l x the a b t trics Gynec  
t ob t 19 4 384 386
6. OCK LAD NELS I nd DILLOV T G The eof  
eph d ne in p la x thes a J Am M As  
9 7 1 35
7. OLDI P S T th e pe es a d es lt th  
l ar th i in of t trics An th & Anal  
9 7 9 06
8. PIR IN GEORG F C trollabl pi al an sth  
J M S N Je cy 9 7 x iv 4 5 438
9. RI ACT S J l WITZ R Sp l n the  
l t d t tle p l egn by th u e of  
cit ted s lut f o a Bull Soc d b t  
t d gvn 9 7 4 4
- SIS L COLN F Th u e f ephed pin l  
n th S g Cl N Am 9 3 95 00
- S L LINGCOL F K L Y FRANK A W th u,  
I DERICK S Pe so al num t
- S ITI G C and P RT R W T Spin la  
the n the c t Am J Physiol 9 5 xxxv  
03 7
3. A A P S nal x th ob tetn  
Bru ll m d 9 3 845
4. WILHIA I W ITRIDGE The t emu of p e  
n y and th t tment of e lamp ia J Am  
M A 9 7 1 449 4 4
5. Y T CARL C S l nal x t l S g Gy c d  
Ol t 9 7 xv 40-45

## THE IMPORTANCE OF EARLY TRACHEOTOMY

B. WILLIAM H. JRIOTEAU M.D. CLIN. LANC. O.HO.

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**T**RACHEOTOMY is a word which has long been associated in our minds with exhaustion pneumonia cardiac failure and death. This association we feel unwarranted and is due to the fact that in the rare case in which the operation is necessary the results are unfavorable because operation is usually deferred too long rather than because of any intrinsic fault in the operation itself. When performed early, tracheotomy is very much more effective as a strength conserving and life saving measure than when it is used as a last resort.

One of the most valuable uses of tracheotomy is to relieve laryngeal obstruction which may follow an operation on the thyroid gland and it is to this type of case that we have particular reference in this paper. The obstruction in such

a case may be due to bilateral abductor paralysis either temporary or permanent when the vocal cords are approximated in the midline or it may be due to edema of the larynx or to deep cervical hemorrhage. Other conditions which sometimes necessitate tracheotomy are carcinoma of the larynx and of the thyroid and deep cervical infections.

The obstruction may occur during operation or at any time after it but it almost never occurs after more than 60 hours. When obstruction occurs during operation it is generally due to posture and to traction on the gland. If that is the case it will clear up very shortly upon relief of the causative factor. In the rare cases in which obstruction develops months or years after operation it is due to involvement of the

recurrent laryngeal nerve in the scar tissue and in such cases the prognosis is very poor.

The characteristic sign of nearly all types of laryngeal obstruction is inspiratory stridor which is more pronounced when the patient is sleeping. If it is of any considerable degree the patient complains of difficulty in getting sufficient air and uses the accessory muscles of respiration. The face is anxious and often large doses of morphine fail to induce sleep. Tachycardia and weakness of the pulse may appear early but generally they are late symptoms especially in a calm patient with some reserve strength. Cyanosis is generally of serious significance and except in cases in which an almost complete obstruction develops quickly it is an indication that the partial obstruction has been present for a considerable length of time and that relief should have been given earlier. A strong voice which however is monotonic, is often present and may be misleading. Examination of the larynx will generally reveal the cause of the obstruction. If it is due to bilateral abductor paralysis the cords will be seen to be approximated in the midline.

The complaint of the patient is the most important indication for a tracheotomy. A slight obstruction which is borne with ease by most patients may be a serious burden to a very weak and nervous one. If the cords are seen to be fixed in the midline a tracheotomy should be performed at once. If the obstruction is of slight degree and if there is some space between the cords it is justifiable to defer the operation for several hours in the hope that it will not be necessary. In this connection however it should be emphasized that delay is especially dangerous if the patient has little reserve strength. If there is any doubt it is much safer to perform the tracheotomy as the tendency is for laryngeal obstruction to increase once it has developed to any degree. This tendency to increase is accounted for by the increasing congestion and oedema. Many cases may clear up by the use of an oxygen tent but they should be watched very closely and if any signs of an early exhaustion are present an immediate tracheotomy should be done.

One of the fundamentals of present day surgery is to conserve the strength of the patient and it is just this which early tracheotomy does for when the operation is performed early the general condition of the patient has not become impaired by a long fight for sufficient oxygen. The mental condition is clear and the patient is able to co-operate. The cough reflexes are present and are not deadened by fatigue and by large amounts of morphine and there is also a minimum of mucus in the bronchi. Another advantage is that the operation can be better and more safely performed since great haste is unnecessary.

In contrast to this is the picture seen when tracheotomy is performed late. The patient is exhausted and often cyanotic and the pulse is weak. The bronchi are full of mucus and the patient is unable to cough after the tracheotomy has been performed. Not infrequently so much morphine has been administered that artificial respiration is necessary after operation. There is considerable evidence to show that a long continued laryngeal obstruction predisposes to massive pulmonary atelectasis. The operation is technically more difficult since it must often be done in haste and because the patient is unable to co-operate. Moreover respiration not infrequently ceases entirely as soon as the neck is extended to expose the trachea.

The one objection to early tracheotomy is that occasionally the operation may be performed unnecessarily. However this is rarely the case for as we said before the tendency is for laryngeal obstruction to increase and even should tracheotomy be performed unnecessarily very little harm will have been done. The tube can be removed in several hours and the opening closed while the time necessary for the wound to heal will be but little prolonged. On the other hand in the rare cases in which the operation appears to be indicated and the tracheotomy is postponed in the hope that it will be unnecessary the morbidity and mortality are greatly increased.

In a subsequent communication the technique of tracheotomy and the after care of the patient will be described.



# EDITORIALS

## SURGERY, GYNECOLOGY AND OBSTETRICS

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NOVEMBER 1928

### CHRONIC SUBDURAL HÆMATOMA

CHRONIC subdural hæmatoma is an intracranial lesion closely simulating a neoplasm in its manifestation. Usually it is the direct result of a head injury, although in the majority of cases a history of trauma is difficult to elicit.

With the advent of the mechanical era which developed the first train, the motor car and the aeroplane, traumatic surgery has left the hands of the industrial surgeon and has become more a part of the work of the general surgeon and the general practitioner. Head injuries, either fractures of the skull or concussion, demand immediate attention, often necessitating hospitalization and are classified as emergencies. However, the sequelæ of such injury often require more careful study and consideration.

Chronic subdural hæmatoma may manifest itself at any time from 5 weeks to 10 months subsequent to the accident and its onset is so insidious and its symptoms so protean that it is difficult to distinguish it from intracranial neoplasm. Many times the symptoms are merely those of increased intracranial pressure

without localizing signs and coma may supervene to complicate the clinical picture.

Chronic subdural hæmatoma is now being observed more frequently and is being operated on in the early stages with excellent results. Sometimes the history is baffling and on casual examination a deep seated intracranial neoplasm may appear to be present. A careful history and thorough examination should elicit (1) a history of head injury, either slight or severe, followed by an interval free from symptoms, and the insidious development of increased intracranial pressure, (2) papilloedema or a field defect, and (3) sensory or motor impairment which might indicate the site of the lesion. If the site of the lesion has been determined, exploratory craniotomy is indicated and the hæmatoma can be removed completely. Certain writers consider the advisability of drainage, but statistics show that complete closure is just as successful and avoid the added danger of secondary infection.

From a surgical standpoint, chronic subdural hæmatoma is spectacular. Its presence is signified by a pigmented overlying dura which on incision reveals what appears to be an organized blood clot in the subdural space; however, it differs from pachymeningitis hæmorrhagica interna in that its surface has not the laminated appearance so characteristic of this condition. On palpation it usually fluctuates and within the capsule there is fluid of different color and consistency depending on the duration of the lesion. When aspirated the fluid resembles bile and after the cavity has been evacuated the capsule can be stripped away from the underlying pia arachnoid leaves

ing normal appearing compressed cortex beneath

Pathologically the lesion is an organized blood clot whose center has liquefied and whose capsule shows fibrous organization interspersed with mesothelial cells which have invaded it ostensibly from the meninges. These mesothelial cells have been classified as a part of the reticulo endothelial system of cells and closely allied to the Kupffer cells of the liver while the fluid contained within the hematoma corresponds to biliverdin and bilirubin resulting from the reaction of the mesothelial cells on the hemoglobin contained within the structure. Virchow's classic description of the lesion in 1857 has continued to remain outstanding and his conception of the etiology and the relation to the surrounding tissues remains undisputed.

Because of the unequivocally successful results of operative procedures in cases of chronic subdural hematoma such a lesion should be considered as a possibility in the differential diagnosis of intracranial complication.

WINCHELL MCK. CRAIG

## CONVULSIONS

CONVULSIONS have puzzled the wits of men for ages. They may be associated with certain diseases with injuries or with intoxication from drugs. Uremic convulsions from urinary obstruction may be relieved by surgical measures. Care of expectant mothers may do much to prevent convulsions arising from the toxemia of pregnancy and care during parturition will do much to prevent injury to the child which may lead to convulsions. Neurosurgery has something to offer for the relief of convulsions associated with brain tumors, abscesses and injuries. There are however certain convulsive seizures that defy treat-

ment or explanation. These are referred to as 'idiopathic' and should mark the frontier of research on the problem of epilepsy. Various hypotheses with regard to the etiology have been applied to idiopathic convulsions one of which is heredity. It has been inferred that natural phenomena explain such manifestations inasmuch as some animals (the opossum and certain beetles) display similar behavior in defense. Psychogenesis has been used as an explanation as well as unknown toxic agents supposed to arise in the course of metabolism. The endocrine glands have been suspected. There may be elements of truth in all hypotheses but from them there is little to offer the patient. The etiology is elusive and obscure.

Certain clinical and experimental observations of the last decade or two may throw light on the problem. Dandy has demonstrated on dogs that injury to the motor cortex lowers the threshold for the production of convulsions. To produce seizures in dogs so injured only from one third to one seventh of the dose of abinthe was necessary as compared with normal animals used as controls. From Dandy's work it might be implied that injury to the motor cortex is probably fundamental in the cause of convulsions.

It has been found that convulsions may be induced when the blood sugar is reduced to a low level by an overdose of insulin. Wilder, Allen and Robertson report the case of a man who became unconscious when he became hungry. If he was not relieved by the ingestion of sugar or candy convulsions developed. The blood sugar was extremely low during unconsciousness. He became progressively weaker and died. At necropsy it was found that carcinoma of the islands of Langerhans had metastasized to the liver and lymph nodes. Extracts of the metastatic growths injected intravenously into a rabbit

caused marked reduction in its blood sugar. In another case a young slender rapidly growing high school girl for cosmetic and athletic purposes abstained from eating a sufficient amount of food and light convulsions developed when she awakened in the morning. The blood sugar was low. She was given a lump of sugar each morning on awakening together with sufficient food during the day and the convulsions disappeared.

There are various ways in which diet has been regarded as a factor in health and disease. The importance of the ketogenic diet for the relief of convulsive seizures especially in childhood is attracting much attention. Beriberi, a disease of the nervous system seems definitely traceable to dietary deficiency. Pellagra and pernicious anemia both diseases in which the nervous system may be affected have been regarded as deficiency diseases. They respond somewhat to dietary treatment. From the standpoint of diet probably no observations are more significant than those of Hughes who reports a disorder of the nervous system invariably produced in young pigs by a diet free from vitamin A. The syndrome consists chiefly of ataxia, blindness, paralysis and convulsions. Only partial recovery takes place when the diet is corrected.

Hughes work suggests the effect on the brain of the fetus if the mother does not get

enough of vitamin A by reason of the seasonal locality, capriciousness of appetite or hyperemesis gravidarum. But even if the child fares well before birth and is not injured at birth in early childhood his brain may have to endure for various reasons the insult of improper food and through life suffer the defect. Thom found that convulsive seizures began before the age of four in 51 per cent of epileptic cases. He quotes from Elliot who found that fewer convulsions developed in cases of rickets treated early than in those untreated.

In summarizing it may be said that idiopathic epilepsy is probably due to injury to the brain which enables smaller insult agents to induce convulsions. Injury probably occurs early in life and must be insidious and obscure to escape detection. In the light of recent work on vitamin deficiency the health of expectant mothers and the food of children should be given every consideration to prevent the type of injury to the brain that never can be repaired.

LLOYD H. ZIEGLER

#### BIBLIOGRAPHY

1. DONDY, W. F. Experimental investigation of the effect of vitamin A deficiency on the brain. *J. Am. Med. Ass.* 97:1 90-91
2. HUGHES, J. S. Relationship of vitamin A deficiency to nervous diseases (Unpublished thesis).
3. THOM, D. A. Infantile convulsions. *Arch. Pediatr.* 9:7 1922
4. WILKINSON, R. M., ALLEN, I. N., JONES, M. H. and ROBERTSON, H. E. C. C. The effect of vitamin A deficiency on the brain. *J. Am. Med. Ass.* 1927:1 348-350





ABNER W. CALHOUN  
1840-1910

# MASTER SURGEONS OF AMERICA

ABNER WELLBORN CALHOUN<sup>1</sup>

IT is altogether fitting and proper that the memory of Dr. Calhoun should be enshrined in the Abner W. Calhoun lectureship foundation. His achievements as citizen, soldier, physician, and teacher constitute a distinguished chapter in the chronicles of the history of this great state and add luster to the records of many other notable accomplishments of which you are justly proud.

Dr. Calhoun was fortunate in his parentage and the guidance thus bestowed and the register of the events of his life portrays the unfolding and development of his sterling character and his resolve to do the work in hand with scrupulous and unaffected dignity, freely and justly.

Introduced by his father to the study of medicine, he matriculated in the Jefferson Medical College of Philadelphia and was graduated as the honor man of his class well nigh 60 years ago. Especially interested in the study of anatomy in his student days, he continued that interest when he went abroad shortly after his graduation. Attracted by the eminence of Hertel, he spent all available hours in his dissecting room where indeed for a time he was his prosecutor. During this period he was offered the chair of anatomy in the Atlanta Medical College. How better could he have laid the foundation for his future career as a notable exponent of one department of special surgery wherein he was destined to attain a prominent place than by acquiring proficiency in this important fundamental branch of the medical sciences.

Doubtless influenced by his father, he realized the necessity of gaining specialized knowledge and experience in ophthalmology and otolaryngology and with characteristic energy and ambition sought and obtained instruction in the clinics of the masters of those days in these departments of medical and surgical work.

Fully and admirably equipped, he returned to his own home and was elected professor of ophthalmology and otolaryngology in the Atlanta Medical College of which his father had been one of the founders. He continued with praiseworthy ability to fulfill the duties of this distinguished post until the day of his death, serving not alone as teacher but as administrator and in all the ways he was able admirably strove for its development and improvement.

Addressed by me to the Abner W. Calhoun Lectureship Foundation, Georgia, June 1, 1931

His success was immediate and there gathered about him an extensive clientele the most extensive this Southland has ever known. From far and wide his patients came seeking the help of his clinical and his operative skill and no one rich or poor sought this benefit in vain.

His commanding presence, his distinguished personality, his utter friendliness, his high ideals, his balanced judgment, his untiring energy, his manual dexterity—thee were the assets of this gifted man, spent with fine liberality for the advantage of his adoring patients and of his admiring students.

His was the hand which restored to countless hundreds the priceless heritage of sight. He lived his life abundantly. Of him it may be said as it has been said of another great physician—the very name of him was Victory.

Deeply concerned with the obligations and responsibilities of medical and surgical practice, he nonetheless found time to accept and faithfully to perform the duties which pertain to organized medicine—to teach to the eminent satisfaction of his students—to contribute liberally and efficiently to the literature of the Department of Medicine and Surgery, he so well adorned—to engage effectively in public affairs—and to be an outstanding citizen imbued with the spirit of civic righteousness and of business rectitude.

He was a great physician and a great gentleman. He belonged to that rare group of men who find hidden joy in every perfect service and who give fine example of the conduct of the higher life.

In my early days long ago it was my privilege to visit Dr. Calhoun. This was a happy circumstance in my life. The impressions then gained have never failed. I am honored in the opportunity of paying him tribute, albeit inadequately framed and spoken, but I pay it reverently and in that reverence I know you join.

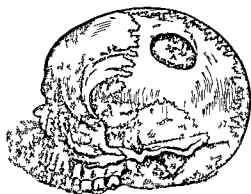
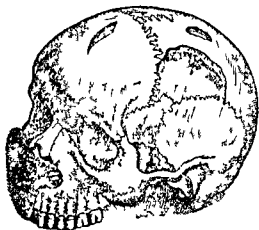
I quote some recently published lines, somewhat altered in their relations and yet appropriate:

A d wh he l k d h th t d f  
 Wh l a t l r v a t f l a d  
 H l th t l d d l d t s h o h g h  
 T l d r t l l i o d  
 M n l y t a h t h h  
 H e t b f g t t a l y h o

G. E. DE SCHWEINITZ







# THE SURGEON'S LIBRARY

## OLD MASTERPIECES IN SURGERY

By ALFRED BROWN M.D. F.A.C.S. OMAHA, NEBRASKA

### THE SUCCENTURIATUS ANATOMICUS OF PIETER PAAW

THE mystical superstition that the brain is the home of the human mind and soul has been handed down since the dawn of time. Evidence of this belief is found in the skull showing trephine openings which have been found in prehistoric burial places in many lands the widely separated countries from Peru to France and Japan to Portugal showing the general prevalence of the idea. Naturally we cannot be positive that these early skull operations had to do with such a belief but if we start from the premise that this was the idea of the early trephining operations of which we have knowledge and reason from this it seems fair to assume that they were performed for some abnormality that had to do with the psychic rather than the physical side of the patient. Broca suggested that in addition to the superstition that the ego resides in the brain there was also a religious element in the operation so that it partook of the nature of a religious ceremony. The patient when and if he recovered became exalted to the status of a holy individual. Later demonology appeared and played its part in human philosophy. An insane man was presumed to be possessed of devils which had their dwelling place in the brain. Again the trephine came into use as a means of liberating devils. These various theories called attention to the brain as the most important element in the human make up.

Such a condition of affairs brought the diseases and injuries of the skull and brain into a position of great importance and made them a most alluring subject for the surgeon who happened to be somewhat philosophically inclined. Hippocrates devoted himself to this specialty of medicine and left his treatise on *Injuries of the Head* in which however as shown by the title he confines himself to trauma alone. After Hippocrates nearly every surgeon who wrote anything at all had something to say on the subject of head injuries but little new was offered until Berengarius published his treatise in 1518.

Pieter Paaw was born in Amsterdam in 1564 and took up the study of medicine when he was only 16 years of age beginning at the University of Leyden. Upon the completion of his course he took up post graduate work in the famous schools at Paris, Orleans, Rostock, and Padua until he was called back to Amsterdam by the illness of his father. At

these various schools he came in contact with many of the great men of the day: Hieronymus Bontius, Justus Lipsius, Dodoneus, Bruscius, and Fabricius of Acquapendente. By the time he reached Paris he had evidently made up his mind to devote himself to anatomy as his main objective for he continued that study both in Rostock where he gained his doctorate in his twenty-third year and in Padua.

Upon his return to Holland he became the professor of anatomy and Botany at the University of Leyden. Holland lagged behind the other countries that Paaw had visited in that anatomy was still considered as a theoretical subject and part of philosophical medicine. Paaw evidently changed the custom for we find that in 1597 the University built an anatomical theater and the following year the government of Holland granted to the professor of anatomy the right to dissect the human body. Of this privilege Paaw took advantage and in 2 years dissected 60 human and many animal bodies.

Though Paaw's writing was largely along the line of anatomy and his principal works *Prænotio anatomica*, *First Fruits of Anatomy Concerning the Bones of the Human Body* in 1615 and his re editing of the *Epitome of Vesalius* in 1618 were purely anatomical he did apply his anatomical research to the subject of fracture of the skull and published his book on the subject in 1618. He bases this work on Hippocrates' *Wounds of the Head* and the first four chapters of the eighth book of Aurelius Celsus upon the diseases and injuries of the bones and joints.

In this work Paaw has applied his knowledge of anatomy both normal and abnormal to explain the diseases of which Hippocrates and Celsus write and adds his own commentaries in correction of errors where he thinks it necessary. The most striking part of the book is the collection of copper plates which he uses to illustrate the various forms of lesion of the skull and the instruments used in cranial surgery. These are evidently the work of a master engraver for they are beautifully done and due evidently to Paaw's careful direction are in great measure correct.

It would hardly be fair to dismiss the *Succenturiatus Anatomicus* without calling attention to the copper plate portrait of the author which shows him as a typical Hollander in check and all who may have posed for one of the heads in a painting by Rembrandt or Frans Hals.



external appearances of the body are described. As an example the following under Gastric Carcinoma may be cited — External Appearances. The body is that of a man between 40 and 60 years of age. There is anemia with a yellowish tinge of the skin. Sometimes jaundice may be present. Emaciation may be extreme. There may be swelling of the ankles. Secondary nodules of growth may be present in the skin of the abdominal wall. After such a brief summary of the more common external findings the internal appearances are considered by systems of organs. The lesions found in different diseases are named rather than described as for example cloudy swelling fatty degeneration infarction etc. Inasmuch as the description of these conditions can be readily found in the usual textbooks of pathology the brevity which this method permits is probably a gain in that it avoids the confusion

incident to too much detail. At the end of the volume are five appendices giving the average normal sizes and weights of organs the length and weight of a fetus at different stages of gestation the approximate weight of the organs of a newborn child the dates of ossification of the principal bones and the ages of eruption of the teeth.

This volume is pocket sized well bound and printed on good paper without gloss. The typography is clear and the headings of paragraphs are so arranged that they readily indicate the coordination of the divisions of the subject being discussed. This book will not be of any particular interest to one who has had an extensive experience in post mortem examinations but to those for whom it was primarily intended it will serve as a clear brief and on the whole accurate guide to the proper performance of an autopsy.

J P SIMONDS

## BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selection will be made for review in the interests of our readers and as space permits.

BIOLOGIE UND PATHOLOGIE DES WEIBES EIN HANDBUCH DER FRAUENHEILKUNDE UND GEBURTSHILFE. By Jo ef Halban and Ludwig Seitz. Lieferung 44. Berlin and Vienna. Urban & Schwarzenberg. 1928.

PRACTICAL SURGERY OF THE ABDOMEN. By George H. Juilly M.D. Foreword by W. Wayne Babcock M.D. Vols. 1 and 2. Philadelphia. F. A. Davis Company. 1928.

PREVENTIVE MEDICINE. By Mark F. Boyd M.D. M.S.C.P.H. 3d ed. rev. Philadelphia and London. W. B. Saunders Company. 1928.

AN INTRODUCTION TO EXPERIMENTAL PHARMACOLOGY. By Torald Sollmann M.D. and Paul J. Hanzlik M.D. Philadelphia and London. W. B. Saunders Company. 1928.

A TEXT BOOK OF FRACTURES AND DISLOCATIONS COVERING THEIR PATHOLOGY DIAGNOSIS AND TREATMENT. By Kellie G. Speed S.B. M.D. F.A.C.S. 2d ed. enlarged and rev. Philadelphia. Lea & Febiger. 1928.

REQUISITES AND METHODS IN SURGERY FOR THE USE OF STUDENTS HOUSE SURGEONS AND GENERAL PRACTITIONERS. By Charles W. Cathcart C.B.E. and J. N. Jackson Hailey O.B.E. London and London. Oliver & Boyd. 1928.

BULLETIN OF THE NATIONAL RESEARCH COUNCIL. The Coroner and the Medical Examiner. Issued under the auspices of the Committee on Medical Problems. By Oscar T. Schultz and E. M. Morgan. With a Supplement on Medical Testimony. By E. M. Morgan. Washington. The National Research Council of the National Academy of Science. 1928.

DISEASES OF THE EAR NOSE AND THROAT. MEDICAL AND SURGICAL. By Wendell Christopher Phillips M.D. 3d ed. rev. Philadelphia. F. A. Davis Company. 1928.

SURGICAL DIAGNOSIS IN TABULAR OUTLINE FOR STUDENTS AND PHYSICIANS. By Dr A. J. Cernach. Authorized Translation with Additions and Note. By Edward L. Bortz M.D. With an Introductory Note. By John B. Deaver M.D. Philadelphia. F. A. Davis Company. 1928.

A PRACTICAL MEDICAL DICTIONARY. By Thomas Lathrop Stedman A.M. M.D. 10th ed. rev. New York. William Wood & Company. 1928.

INTERNATIONAL CLINICS A QUARTERLY OF ILLUSTRATED CLINICAL LECTURES AND ESPECIALLY PREPARED ORIGINAL ARTICLES ON TREATMENT MEDICINE SURGERY ETC. Edited by Henry W. Cattell A.M. M.D. with the collaboration of others. Vol. III. 38th series. 1928. Philadelphia and London. J. B. Lippincott Company. 1928.

RECENT ADVANCES IN SURGERY. By W. Heneage Ogilvie M.A. M.D. M.Ch. (Oxon.) F.R.C.S. Eng. Philadelphia. P. Blakiston's Son & Co. 1928.

A TEXT BOOK OF SURGERY FOR STUDENTS AND PHYSICIANS. By W. Wayne Babcock A.M. M.D. F.A.C.S. Philadelphia and London. W. B. Saunders Company. 1928.

ANNALS OF ROENTGENOLOGY A SERIES OF MONOGRAPHIC ATLASSES. Edited by James T. Case M.D. Vol. VII — Urological Roentgenology. By Hugh H. Lyon M.D. and Charles A. Waters M.D. New York. Paul B. Hoeber Inc. 1928.

SINUS THROMBOPHLEBITIS INFLAMMATORY DISEASES OF THE VENOUS SINUSES OF THE DURA MATER. By Alfred Braun M.D. New York. Paul B. Hoeber Inc. 1928.

AN INDEX OF DIFFERENTIAL DIAGNOSIS OF MAIN SYMPTOMS BY VARIOUS WRITERS. Edited by Herbert French C.B.E. (Military) M.A. M.D. (Oxon.) F.R.C.P. London. 4th ed. New York. William Wood & Company. 1928.

DIAGNOSTISCHE UND THERAPEUTISCHE IRRTÜMER UND DEREN VERHÜTUNG CHIRURGIE. Edited by Prof. Dr. J. Schwalbe. Vol. IV. Leipzig. Georg Thieme. 1928.

# AMERICAN COLLEGE OF SURGEONS

## INAUGURAL ADDRESS

### THE EVOLUTION OF CLINICAL MEDICINE AND SURGERY IN RELATION TO THE PRESERVATION OF HEALTH AND LIFE

BY FRANKLIN H. MARTIN, M.D., PRESIDENT OF THE COLLEGE

#### I. INTRODUCTION

NO greater honor can come to a surgeon than to have conferred upon him the presidency of the largest and one of the most influential surgical organizations of the world—the American College of Surgeons. My friends from the bottom of my heart I thank you for this distinction, though I must confess I consider myself unworthy to occupy a position of such responsibility.

In my address I shall attempt to portray the present evolution of the ART and SCIENCE of medicine and the part that our profession and the public should have in guiding its successful progress. I shall review the efforts the American College of Surgeons has put forth and will I trust continue to put forth to aid progressive co-operation between the profession and the public in this important movement—the preservation of health and the increased happiness of humanity.

#### II. THE AMERICAN COLLEGE OF SURGEONS

Those who visualized the American College of Surgeons organized it and have been responsible for its administration realized from its inception that just to organize another surgical association just one more academic society was not a reason to warrant its creation. The College to justify its existence would have to assume the responsibility of building for broader science for more worthy practice for interest in sustaining the traditions of the greatest profession and by the example of its Fellows and through open discussion impress upon the public the significance of scientific medicine as THE ONE AUTHORITY qualified to maintain the health and insure the wholesome living of all people.

#### III. OUR CREED

It was a bold announcement—the declaration by the Founders of the College at its inception

that not only would the standard of surgery be elevated but the public would be admitted into the confidence of the profession and the aid of the public solicited to accomplish the ambitious program of the College. Conservatism and conventionalism within and without the profession asked in astonishment: Is it possible that this group of men is actually serious in advocating so revolutionary a program?

On this the fifteenth anniversary of the existence of the College I venture that the profession and the laity in the United States and Canada are prepared to answer that query in the affirmative and to acknowledge that the American College of Surgeons is fully justified in assuming that its leadership is recognized not only as progressive but safe.

#### IV. THE AUTHORITY OF SCIENTIFIC MEDICINE

Among the learned professions medicine has no equal in longevity in continuity in ideality in disinterested service and in accomplishments. For twenty five centuries medicine exhibits a clear history. Its spiritual and moral creed—the Hippocratic Oath—announced at that early beginning has been and is as fundamental in the guidance of the true physician as the Sermon on the Mount (first uttered five hundred years later) in the guidance of the true Christian. Spiritually, morally and scientifically in all civilized countries scientific medicine is outstandingly the recognized authority in the prevention and cure of disease. Like the great religions of the world it recognizes no geographical bounds but unlike the great religions it has no division of authority.

A recital of the long chain of distinguished men of medicine with many links centuries long reveals an unmistakable continuity. To mention them individually is to count the beads of a great rosary one by one each bead a jewel of rare worth and beauty. It is a record of singular interest

Every physician is assumed to have a knowledge of this history but he should know it accurately and for protective information the cultural education of each person—man woman and child should include facts of medical history

### V WE SHOULD BE DEFINITE

For centuries the ART of medicine was paramount. This art was based on records which represented careful study of diseases the effect of drugs and the performance of operations in dire emergencies only. Familiarity with the action of drugs was discovered and developed to an astonishing degree of exactness and the proficiency with which the experienced practitioner influenced the different shades of diseases would excite the admiration of the skilled practitioner of our present ultra scientific age. Like a master musician the physician of yesterday studied and knew his organ and no note was too subtle for him to reproduce.

### VI SCIENTIFIC MEDICINE

The nineteenth century saw the development of the pure sciences. Rapidly these were absorbed by the medical profession and now more than ever we may say that we practice the SCIENCE as well as the ART of medicine. Long experience in recorded observation is not the only basis of our accomplishments but as well the mathematical certainties of pure science and its instruments of precision.

During twenty five years I have had an unusual opportunity to observe the rapid changes in the development and practice of clinical medicine and surgery. Besides the practice of surgery this experience was gained in five activities: organizing and administering SURGERY GYNECOLOGY and OBSTETRICS developing the Clinical Congress of Surgeons founding and conducting the American College of Surgeons responsibility of organizing the lay medical corps for service in the Great War and reorganizing the Gorgas Institute of Tropical and Preventive Medicine. In the development of these five important activities I have been intimately in touch with the profession and as an innocent bystander I have accumulated knowledge and not a few notions about the present evolution.

It is my purpose this evening to review some notable events from a mass of material that has been systematically compiled and placed in manuscript form whose reading would be interesting but whose presentation in an address would be appalling.

First and foremost are the scientific accomplishments that have definitely modified and controlled specific diseases and incontrovertibly conserved

life and health in a revolutionary manner. The work of Pasteur and its adoption by Lister in the development of antiseptic surgery the outstanding pursuits of Koch in modifying tuberculosis the epoch making researches by Behring Roux and Klebs in controlling diphtheria the indefatigable labors of Ehrlich in furnishing a remedy for the spirochetal diseases the achievements of Roentgen of Eberth in well nigh exterminating typhoid fever the painstaking accomplishments of Bruce in sleeping sickness Ross and Laveran in malaria our own Reed Finlay and Gorgas in yellow fever Banting in diabetes and the Dicks in scarlet fever. These specific accomplishments have resulted in saving more lives each year than were lost in the Great War.

### VII DEGENERATIVE DISEASES OF MIDDLE LIFE AND OLD AGE

There are certain other diseases that reap a large death harvest and a much greater disability. Though we have not a specific for each we have definite proof that they may be modified or cured if discovered early. These include the degenerative diseases insidiously begun in middle life and exaggerated in old age notable among them cancer with a mortality of 115 in every 1000 deaths though if recognized early it may be cured heart disease that makes its deadly swath in individuals in the most productive period of life 140 to every 1000 deaths may be modified if early recognized and appropriately treated diseases of the kidneys and blood vessels with their harvest in middle life of 110 in 1000 deaths. Preventive medicine or the early application of curative measures in these diseases would save thousands of lives each year.

So to extend longevity to any material degree we must first discover the cause of and secure a remedy for degenerative diseases. It is my prophecy that we are on the eve of solving the unknown problems which pertain to the diseases that cause unforeseen and unexpected tragedies in middle life and that germinate and foster the dread of incapacity in old age.

The degenerative diseases cause one third of our deaths. They are definitely influenced by current incidents as habits of living strenuous mental activities improper diet excessive use of stimulants particularly alcohol lack of proper exercise and recreation and infectious diseases that thrive on a weakened resistance. They are the result of age or its equivalent—excessive work.

Within a year at the Third Race Betterment Conference President C. C. Little of the University of Michigan stated

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## VII WHO RESISTS THE BENEFITS OF SCIENTIFIC MEDICINE?

Though it be impossible to speak with exactness it is a safe assumption that of the 130 000 000 people in the United States and Canada one half of those of reasoning age have no familiarity with the simplest fundamentals of the laws of health. While this proportion of our population is ignorant of the importance of health laws it is again a safe assumption that false teachings by propagandists and one or another reasons have led at least another one fourth of our reasoning population to develop a positive antagonism to scientific medicine and definite resistance to its services. Those who oppose scientific medicine thrive more or less successfully according to the advertising zeal of their leaders they represent the various sects, cults and organizations of proprietary and patent medicines.

## VIII RESULTS OF THIS RESISTANCE

If it is true that one fourth of our population of reasoning age represents active opposition to curative medicine and succeeds in avoiding its ministrations here is a sound basis on which to estimate the effect of this on the health and mortality of the whole population.

Thus our favorable showing is possible with non resistance or indifference of one half of the population of thinking age. Estimating that one of every four resisted the services of scientific medicine—refused vaccination for smallpox, anti toxin for diphtheria and appropriate prophylaxis in the other preventable diseases—a large proportion of the present death rate in these diseases is avoidable and may be attributed to this resistance. An ultra conservative estimate (under accepted methods of statistical study and mathematical calculations) will attribute to this one sin of omission 8 790 6 avoidable deaths in 1925 and 87 906 avoidable deaths in the ten years 1915 to 1925.

With one fifth of our population yielding to and accepting an annual health audit (as our figures indicate) with two thirds of them sympathetic to curative medicine and with two thirds spiritually and morally in favor of the enforcement of the 18th Amendment we need not wait until the next decade or the next century to reap the benefit in life extension.

## IX EDUCATION IS NECESSARY

The remedy is but too obvious. There must be continuous education. The fundamentals of scientific medicine its practicability and acceptability should be taught in the primary classes of our

public and private schools as early as the seventh or eighth grades. The fundamental principles of scientific medicine should occupy the same relative position of importance in the grade schools as grammar general and physical geography lower mathematics and English literature. The influence of these principles on personal and public health should be emphasized and reiterated and knowledge imparted of the laws of general hygiene and sanitation.

A number of experiences in addressing school children convince me that education in the basic principles of scientific medicine would be accepted by them with great enthusiasm and the leaven there sown would be of incalculable aid in lessening the existing ignorance and indifference toward the maintenance and promotion of better health. Moreover in a dignified and proper manner it would be a potent factor in combating misinformation which uncured develops into opposition to the truths of scientific medicine.

The five million men who served in our armies in the Great War were quick to appreciate the importance of the policy of our medical department to KEEP THEM WELL. The demonstration in the armies of our allies and enemies was even more impressive as their men were under scientific medical surveillance for longer periods. So as tounding were these demonstrations that practically every country engaged in the Great War (excepting of course the United States) was forced by public opinion of their soldiers to add to their respective cabinets a portfolio on medicine under whose supervision curative medicine was made accessible to all people.

## X PERIODIC HEALTH EXAMINATIONS

I preventive medicine and its counterpart periodic health examinations have been discussed since the earliest days of medical science. If scientific medicine has established its right to assume the responsibility of supervising and maintaining the health of the people it is a foregone conclusion that it should examine each and every individual at definite intervals and give advice based on the findings.

Resistance to this obviously significant policy is a sin of omission due primarily to the short sightedness of the physician who is educated in and practicing scientific medicine and secondly to indifference of the public which is the beneficiary of such a policy.

This subject has been much in evidence in the last ten or more years. No one group of physicians no one organization alone can successfully influence this change.



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 l m u t t 140 To the u p p e r a g e l m t  
 f l f t t t o m k w m m a g f h u m  
 b i g s a d t m k t f l y c o m m t h g t a t t i n t h a t  
 g w l d m n t h t w w l d h t o e t e n d o p o l o g  
 p k w n l t y A l l f k o w w h t t m e  
 t g o w o l d W h l d i t h e h a t p l g t h t p o c e  
 f g w g l d m k g t m g d a l o r w h o l d l  
 t t e d t t l g h g e t h a t p t p i t s s t a t  
 N t h f t h t l g y y t d I t s l g t h t  
 l p h p t h t l p g h t m d e t h t h  
 l m f m v t l t c d d l w o u l d l e d t  
 l l w t h

It is my belief that this statement was dangerous as it was put forward by an influential teacher of men and women. It is an opinion of a pure scientist who bases his statements on accepted and established scientific facts, but we are reminded every day by the world's progress that so-called scientific facts are not necessarily permanent facts. Frequently they have been and are being and will have to be revised as knowledge is augmented and experience advanced.

Diabetes is the result of degeneration of gland tissue in which is secreted a substance that aids in regulating the absorption of sugar in the circulation. Dr. Moses Barron of Minneapolis in an article in *SURGERY GYNECOLOGY AND OBSTETRICS* revealed a method of isolating that secreting tissue. Barron's article was read by another (then obscure) student whose mind was not cluttered with scientific facts that dimmed his vision. He rushed across the Atlantic, placed his conclusions before his laboratory teachers in his Alma Mater in Toronto and gave to medicine Insulin, a remedy for diabetes, one of the great discoveries of the age.

Would Edison, if he were told that the degenerative diseases were said by scientists to be unmodifiable, say, "Well, then we must give it up? Wouldn't he say that many things are being wrought every day that seemed impossible of accomplishment in the light of science and tradition?"

The science of chemistry, endocrinology, biology, physiology, clinical pathology and basal metabolism is tickling and solving new problems every day. Adrenalin, thyroxin, insulin and pituitrin are examples of exact and progressive accomplishments. Undoubtedly the substances that will control the degenerative diseases are now in the making.

Scientists today are mining the materials men of vision are fitting these materials into prac-

ticable theories and practical men are straining at their leashes ready to utilize these materials and make great visions come true.

## VIII. PUBLIC HEALTH

We know to a mathematical certainty the contributions of scientific medicine toward public health (in contradistinction to personal health) in comprehensive hygienic regulations and general sanitation. The findings of scientific medicine through civic and other governmental authority are applied to purify the water supply to dispose of sewage to protect and conserve the purity of food to ventilate public buildings and places of amusement—gifts which the lay public has accepted almost unanimously, and all civilized countries realize the extent to which life is protected and wholesome living insured through the provisions of scientific medicine.

## IX. SUMMARIZED STATEMENT

Thus briefly the ever lengthening list of impressive accomplishments reads like a romance. To physicians it is an old story with many side lights, endless in their ramifications. To the layman and woman its history, written in popular style, would be not only intensely interesting but it would be more valuable in stimulating race betterment and human happiness than any biography ever written.

## X. THE HERITAGE EMPHASIZES OUR SINS OF OMISSION

Ours is an unique heritage from a most ancient and accomplished profession. Are we as trustees doing our utmost to perpetuate and extend these doctrines? Is the public unmindful of its legacy through ignorance, indifference or false teaching? Whose is the paramount responsibility to supplant ignorance with knowledge, indifference with interest and false teaching with truth? The practitioners of medicine themselves!!!

## XI. SCIENTIFIC MEDICINE AND PERSONAL HEALTH

In my review I have endeavored to ascertain what would be the result if the doctrines of scientific medicine were applied in a maximum degree toward the conservation and preservation of personal health and toward the alleviation and cure of existing disease. It must be obvious that the effect in prolonging life would be phenomenal and in extending wholesomeness of living and happiness in pursuit of life inestimable. Our past and present methods have confined our activities to curative medicine almost to the exclusion of preventive medicine.

### VII WHO RESISTS THE BENEFITS OF SCIENTIFIC MEDICINE?

Though it be impossible to speak with exactness it is a safe assumption that of the 130 000 000 people in the United States and Canada one half of those of reasoning age have no familiarity with the simplest fundamentals of the laws of health. While this proportion of our population is ignorant of the importance of health laws it is again a safe assumption that false teachings by propagandists and one or another reasons have led at least another one fourth of our reasoning population to develop a positive antagonism to scientific medicine and definite resistance to its services. Those who oppose scientific medicine thrive more or less successfully according to the advertising zeal of their leaders they represent the various sects, cults and organizations of proprietary and patent medicines.

### VIII RESULTS OF THIS RESISTANCE

If it is true that one fourth of our population of reasoning age represents active opposition to curative medicine and succeeds in avoiding its ministrations here is a sound basis on which to estimate the effect of this on the health and mortality of the whole population.

Thus our favorable showing is possible with non resistance or indifference of one half of the population of thinking age. Estimating that one of every four resisted the services of scientific medicine—refused vaccination for smallpox, anti toxin for diphtheria and appropriate prophylaxis in the other preventable diseases—a large proportion of the present death rate in these diseases is avoidable and may be attributed to this resistance. An ultra conservative estimate (under accepted methods of statistical study and mathematical calculations) will attribute to this one sin of omission 8 790 6 avoidable deaths in 1925 and 87 906 avoidable deaths in the ten years 1915 to 1925.

With one fifth of our population yielding to and accepting an annual health audit (as our figures indicate) with two thirds of them sympathetic to curative medicine and with two thirds spiritually and morally in favor of the enforcement of the 18th Amendment we need not wait until the next decade or the next century to reap the benefit in life extension.

### IX EDUCATION IS NECESSARY

The remedy is but too obvious. There must be continuous education. The fundamentals of scientific medicine its practicability and acceptability should be taught in the primary classes of our

public and private schools as early as the seventh or eighth grades. The fundamental principles of scientific medicine should occupy the same relative position of importance in the grade schools as grammar, general and physical geography, lower mathematics and English literature. The influence of these principles on personal and public health should be emphasized and reiterated and knowledge imparted of the laws of general hygiene and sanitation.

A number of experiences in addressing school children convince me that education in the basic principles of scientific medicine would be accepted by them with great enthusiasm and the leaven there sown would be of incalculable aid in lessening the existing ignorance and indifference toward the maintenance and promotion of better health. Moreover in a dignified and proper manner it would be a potent factor in combating misinformation which uncurbed develops into opposition to the truths of scientific medicine.

The five million men who served in our armies in the Great War were quick to appreciate the importance of the policy of our medical department to KEEP THEM WELL. The demonstration in the armies of our allies and enemies was even more impressive as their men were under scientific medical surveillance for longer periods. So astounding were these demonstrations that practically every country engaged in the Great War (excepting of course the United States) was forced by public opinion of their soldiers to add to their respective cabinets a portfolio on medicine under whose supervision curative medicine was made accessible to all people.

### X PERIODIC HEALTH EXAMINATIONS

Preventive medicine and its counterpart periodic health examinations have been discussed since the earliest days of medical science. If scientific medicine has established its right to assume the responsibility of supervising and maintaining the health of the people it is a foregone conclusion that it should examine each and every individual at definite intervals and give advice based on the findings.

Resistance to this obviously significant policy is a sin of omission due primarily to the shortsightedness of the physician who is educated in and practicing scientific medicine and secondly to indifference of the public which is the beneficiary of such a policy.

This subject has been much in evidence in the last ten or more years. No one group of physicians, no one organization alone can successfully influence this change.

I am indebted to James A Tobey Administrative Secretary of the National Health Council for the following brief history of the movement

P d m t f o l f e u c e c o m p e w  
g g e t d t t s b y D D b l l f g l a d l a  
D B I f h y g i t g e d t h m m t w t y  
y m m d t h g b d p t e d t t e t m I t l  
U t d S t t D C g e M C o l d f P h l d l p l a n  
t l t d p p t t l f f f l d t d g u l r  
l t t l y o w l l d t d g u l r  
p l l l g l m t o f p j t l y w e l l  
l d l  
A d h t p l f r l f t w h h l d l  
h m d t l D B d o t f p n d n  
l h l m t l r y f a w a b m t l l n  
A l q d t o t l t n f l f l n d e t  
T l l d t l f A t n f w h d I g e  
t l k w t l M l D t M E I R t t e  
h l d t t h t t d p t h p l f t  
t l y h l d t t l m I o M H J  
M g t t t v f t h t e l I s a C m  
p b d l f m j t t a k p t l  
m u I 4 D S S C l d t C m m n f  
H l t l N Y k c t n d t l t a b l h m e t f  
t l t m m g t i m j l f t l C t v H l t h D  
l t m t T h l t t H M B g g C m m o f t  
N Y k S t t H l t D p t m t l l t  
d t t f h a m t t d t I f I  
m t l l p p l f f t h N t l C f f  
S t l W k W h g t D C M v s t l  
d t g h d t p t t h l t h m t f t  
t t f l l j t t p b l h a l t l f t h t  
t w t y  
H l t l m t n l t l g t t o z  
h l y D r W I C l a k p l h d p p t l  
l j t t h J f f l f l d f p f  
T h f l l g D H f M k l J W S h  
h k p t d l t f m t d t  
P h y l m t f t g l p l l t l l  
l t l l f E t l p r t g b l o 4  
l t t t

Practical work along this line has been enthusiastically developed by the Metropolitan Life Insurance Company.

Special em public organizations conspicuously the National Tuberculosis Association and the American Society for the Control of Cancer the former twenty four years ago the latter sixteen years ago began to urge periodic health examinations so that the signs of the respective disease in which they were interested might be discovered early and later their example was followed by the American Child Health Association the American Social Hygiene Association the American Heart Association et cetera. Naturally it soon became obvious that preventive medicine could be more systematically advanced if the public were educated to accept a comprehensive periodic examination that would reveal the early signs of any disease instead of some particular disease.

The Great War emphasized the wisdom of thorough physical examinations as every country which entered the conflict arbitrarily exacted a medical examination of its soldiers. In some countries the examinations may have been too hastily and too superficially carried out because of the rapid development of the conflict. But the United States with its greater deliberation included in its draft law a provision by which every soldier underwent a health examination conducted not by one physician alone but by a group of specialists.

This no doubt was the most impressive demonstration and certainly the most extensive one on the value of a comprehensive health audit of a large group of apparently healthy men.

The medical corps of the Army under General Gorgas alone accepted for service medically 4,500,000 of these fit men and to secure this number it was necessary to examine approximately 7,000,000 young men. The difference in these figures represents those who were unfit.

These demonstrations with examinations for special diseases gave great impetus to the propaganda in favor of all round periodic examinations. In 1919 and 1920 this organization the American College of Surgeons organized its sectional meetings since which time we have held sessions in practically every state of the United States and every province of Canada. The principal innovation is the carefully planned meeting for the laity at which in simple language the layman and woman are given information on the fundamentals of scientific medicine and especially the advantage of periodic health examinations. The Gorgas Memorial Institute of Tropical and Preventive Medicine was organized in 1911. As the activities of the Memorial have developed it has more and more urged upon the public the importance of seeking an annual health audit by the family physician.

In May 1921 the Trustees of the American Medical Association urged the members of organized medicine through the county medical societies to encourage such examinations. Blank were developed by the Association for that purpose in May 1923 and in 1925 the Association also prepared for the use of physicians a comprehensive manual which contains very useful hints on the method of conducting these examinations. Dr William D Haggard in his Presidential Address before the parent organization very eloquently advocated the periodic health examination and Dr Wendell Phillips made the subject an important theme of his Presidential Address.

### XVI EDUCATED PILOTS

The public should know what we know—that in a large number of our states individuals are licensed to practice the healing art who are utterly ignorant even of the barest fundamentals of scientific medicine. Cultists, some of whom have not even a rudimentary knowledge of the basic sciences of anatomy, physiology, chemistry, bacteriology, pathology, diagnosis, or the other primary essentials of a medical education, cultists, some of whom utterly ignore or denounce the necessity of possessing any knowledge whatsoever of these indispensable requirements. The various cults, under sundry names, have grained the sympathy of legislatures. By subtle sophistry they have passed laws which require farcical examinations in one or another pathy or cult, authorized license to practice medicine or even surgery, and have caused them to be recognized as legal practitioners of the healing art with all of the rights and privileges of the scientifically educated physician.

Of the forty-eight medical practice acts authorized by the individual states of the United States, only five require that an individual to be licensed to practice the healing art shall show by examination that he has a knowledge of the basic sciences upon which obviously the practice of the healing art should be grounded. This means that in the other forty-three states of the United States, not requiring the basic science examination, only the graduates in scientific medicine meet these qualifications.

The new basic science law requires that every practitioner of the healing art shall pass successfully an examination in the basic sciences before he is eligible to present himself as a candidate to the state board of examiners for a license to practice medicine or the healing art in any form recognized in the medical practice act of the respective state. The law drawn up by Dr. William C. Woodward, Executive Secretary, Bureau of Legal Medicine and Legislation, American Medical Association, is in my opinion the simplest basic science law that has been suggested, and at the same time contains all essential protective requirements. The first section of the Enacting Clause reads:

**BASIC SCIENCE CERTIFICATE REQUIRED.** No person shall be eligible for examination or permitted to take an examination for a license to practice the healing art or any branch thereof or granted any such license unless he has presented to the licensing board or officer empowered to issue such a license a certificate of ability in anatomy, physiology, chemistry, bacteriology, pathology, diagnosis, and hygiene (hereinafter referred to as the basic sciences) issued by the state board of examiners in the basic sciences.

### XVII A SOLUTION FOR THE PROMOTION OF SUCCESSFUL HEALTH EXAMINATIONS BY THE PERSONAL PHYSICIAN

In obtaining thorough health examinations, how can we insure the independence of the family doctor, the personal internist, and the favorite surgeon? How insist upon a thorough and complete health audit, save the public from the exploitation of unworthy groups, stock companies, or even the well-organized clinics or well-equipped dispensaries or hospitals, and yet not lose to the personal physician his control of his own legitimate clientele? On this point even the advocates of the health audit have been most apprehensive, and their consternation has led them almost to the point of abandoning the program, lest in spite of its advantages the independent practitioner be put out of business.

The American College of Surgeons is successfully working out a remedy, a supremely practical solution of the problem, that will be satisfactory equally to the laity, the independent practitioner, public health officials, and the hospitals. Obviously, the difficulty lies in the fact that no one practitioner, regardless of ability and eminence, can individually overcome the prohibitive difficulties and make a complete health audit, unless he has at his command competent aids and intricate scientific apparatus and laboratories.

Where is the environment that will remedy this difficulty? Where do Barker, Charles Mayo, Christian, or Cushing find satisfactory surroundings? The answer: In well-organized groups, organized clinics, *the standardized hospitals*. Which of these could, without prohibitive confusion, furnish to the independent physician a place where he could personally make a comprehensive scientific examination of his patient, retain his independence, and not lose control of his own business? A little consideration will answer this query in favor of *the standardized hospital*.

### XVIII THE HEALTH INVENTORIUM

The Health Inventorium is planned by the College to meet this exigency. The suggested plan was submitted to one-tenth of the 1,805 hospitals in the United States and Canada on the approved list of the College in 1917. Almost without exception the plan was accepted. Thereupon the plan was submitted to all hospitals on our approved list in 1927, and finally there is a thorough discussion of the subject at our hospital conference during this session of the Clinical Congress. The fundamentals of the plan have met with almost unanimous approval.

The plan briefly summarized is as follows:

1 Every standardized hospital shall furnish an examining room or rooms to which any legalized practitioner who is a member in good standing of his respective county medical society and the American Medical Association may bring a patient for examination. There shall be no charge for the examining room.

2 The hospital shall furnish to the practitioner every facility in the way of aids and consultants when necessary, laboratory tests etc. as will insure a comprehensive audit of his patient's condition.

3 The charge for the required laboratory tests shall be nominal and a maximum of actual cost.

4 The physician shall render to the patient a bill covering his fee for the examination and where there is a charge for laboratory services he shall be responsible to the hospital for its payment.

5 No hospital shall accord the facilities to any individual who is not accompanied by his or her doctor or who does not carry a letter from his or her doctor in which certain services are requested.

6 An individual who applies for an examination and who has no physician should be referred to a duly appointed disinterested committee consisting of a representative or representatives of the county medical society and the standardized hospital of the community and this committee shall advise the patient in the selection of a physician.

7 Except in dire emergency no hospital shall treat a patient who was examined in the

Health Inventorium except by request or consultation with the referring physician.

#### IX. THE DEMAND FOR HEALTH EXAMINATION AND ITS ACCEPTANCE

It is not surprising that life insurance companies should advocate and be ready to lend financial support toward popularizing periodic health examinations. This commendation only emphasizes their importance. They recognize the movement as a substantial business asset as it will extend the life of their policy holders, reduce the cost of insurance and incidentally substantially increase profits. Are not these facts substantiated by business sagacity? Evidence that you and I as policy holders too will profit in longer life and better health?

Dr Augustus S. Knight of the Metropolitan Life Insurance Company recently at my request gave me figures to indicate the increase of demand and acceptance by the policy holders of yearly examinations advocated and provided by several of the larger insurance companies.

The Prudential Insurance Company of America reports 1500 examined in 1920 and 58000 in 1927 or an increase of 3867% in eight years.

The John Hancock Mutual Life Insurance Company 146 in 1925 1487 in 1926 and 2617 in 1927 or an increase of 1792.5% in three years.

The Penn Mutual Life Insurance Company reports 568 in 1923 1651 in 1927 or an increase of 905% in five years.

The New England Mutual Life Insurance Company did not offer examination until 1925. In

TABLE I—SUMMARY

	1920	1921	1923	1924	1925	1926	1927	Percentage of Increase
Prudential Life Insurance Company of America	1500						58000	3867% (83%)
John Hancock Mutual Life Insurance Company					46	67		79.5% (33%)
Penn Mutual Life Insurance Company			68			65		90.5% (53%)
New England Mutual Life Insurance Company					B	4600		—
Equitable Life Assurance Society	4554					53		540.5% (84%)
Metropolitan Life Insurance Company	94					936		847.4% (83%)
Life Extension Institute	3233					5366		76% (8%)
Continental		47				64		438.7% (63%)

1927 approximately 4 600 examinations were given

The Equitable Life Assurance Society reports 4 534 in 19 0 and 25 030 in 19 7 or an increase of 549 5% in eight years

The Metropolitan Life Insurance Company reports 10 904 health examinations in 1920 and 92 361 in 19 7 or an increase of 847 04% in eight years

Life Extension Institute—13 233 examinations in 1920 105 366 in 19 7 796 2% increase in examinations in 8 years

Cornell Clinic—147 examinations in 192 645 in 1927 438 7% increase in 6 years

The approximate increase in demand for periodic health examinations with companies which give figures for 19 0 and 1927 ranges from the encouraging figures of 549 5% to 3 867% (Table I)

Considering the short time occupied in the experiment this is a showing that demonstrates a substantial interest by the people. Notwithstanding a reluctance on the part of not a few policy holders to accept the service on the ground that it is not an entirely disinterested activity, it is a movement that will develop incalculable health conservation.

### XX INDEMNITY COMPANIES

Our College has been asked by a number of the important indemnity companies and industries who must provide protection to their employees to make a survey that will assist them to give the highest degree of protection to the employed in industry. As a result through our Board on Traumatic Surgery we made careful inquiry into the protective measures and health care that are provided to the great number of employees in large corporations. Our close contact with the hospitals of the United States and Canada makes this new survey dovetail very fittingly and economically with our yearly survey of the hospital field.

### XXI INDUSTRIES

While indemnity companies and state laws furnish protection to men who labor in the industries in the last analysis such indemnity protection is financed by the industries themselves. Wisdom and efficiency have led a considerable number of the larger corporations who employ labor to adopt methods of self protection by furnishing to their men every facility that scientific medicine offers in the way of preventive and curative health measures and similar facilities are provided also to their entire administrative force. The beneficent effect of this system in preserving health and furnishing the best surgical and medi-

cal aid in case of injury or illness is not of less importance because it results in a financial saving to the industries which furnish the aid, but it is the most substantial and effective commendation of scientific medicine and its relation to personal health.

Our survey indicates that this form of humanitarian service has increased enormously since 19 0.

Questionnaires sent 172

Replies received 61 (which represent approximately 844 053 employees)

- 1 Medical service and periodic supervision
  - 7 report complete and compulsory service
  - 5 report partial service
  - 15 report service on employment only
  - 1 reports service after 45
  - 1 reports service for factory employees only
  - 1 reports service for office employees only
  - 6 report no medical service
  - 3 report medical service optional
  - did not answer question
- 2 Attitude toward the service
  - 31 report employees welcome it
  - 6 report employees tolerate it
  - 4 report prefer own physician
  - 20 did not answer question
- 3 Medical service extended to families of employees
  - 5 report yes
  - 19 report occasionally
  - 22 report no
  - 15 did not answer question
- 4 Increase 1920 to 1928 in number of periodic health examinations
  - 1 reports 700%
  - 1 reports 300%
  - 1 reports 100%
  - 4 report 75 to 80%
  - 2 report 50%
  - 4 report great increase
  - 7 report 10 to 40%
  - 2 report no increase
  - 39 did not answer question
- 5 Estimated percentage unsuspectingly harboring some disease or physical defect
  - 5 report 90%
  - 1 reports 75%
  - 4 report 50%
  - 5 report 35 to 45%
  - 4 report 15 to 5%
  - 6 report 10%
  - 4 report 4 to 8%
  - 1 reports many
  - 31 did not answer question

6 Age when degenerative diseases manifest themselves

- 8 report ages 30-40
- 18 report ages 45-50
- 6 report ages 50-60
- 1 reports all ages
- 1 reports depends on individual
- 7 did not answer question

7 Probable result in preventing modifying postponing or curing degenerative diseases

- 6 report much benefit
- 10 report some benefit
- 1 reports one half ignore advice question the value
- 1 did not answer question

8 Probable effect in increasing longevity

- 8 report great benefit
- 6 report increase life from 4 to 10 years
- report increase life from 10 to 20 years
- 4 report some help
- 21 did not answer question

The above summary represents 61 replies from industries which employ 844 053 individual

## XXII LABOR

Labor has not been slow to recognize the importance of this movement. Samuel Gompers outstanding statesman of labor during his life time earnestly and continuously urged his great army of followers to ally themselves with scientific medicine. His worthy successor William Green the present President of the American Federation of Labor is backing the program of our College to improve the status of industrial surgery and medicine. There is no power greater than organized labor to influence the advancement and extension of scientific medicine. Following the demonstration of the care of men in industry especially in the production of munitions and other materials for warfare the average increase in yearly health audits among labor men based on our survey is approximately 95% since 1920. This favorable showing is possible because most of the industries surveyed had similar service in 1920.

## XXIII ARMY AND NAVY

As early as 1903 Theodore Roosevelt with his alert mind looked with appreciative vision upon this problem of keeping physically fit and characteristically he acted. Why have weak links in the United States Army Navy Marine Corps and Public Health Service when by proper medical supervision the unfit units could be weeded out? From that time to the present the United States soldiers sailors and marines have been submitted to regular physical examinations. The

benefits of that program are now extended to the members of their families. By this regulation alone over one million citizens are examined yearly and receive the benefits of preventive medicine.

## XXIV UNITED STATES ARMY NAVY AND GOVERNMENTAL DEPARTMENTS

Questionnaires sent 10 Replies received 9

- 1 Are medical service and supervision provided
  - 2 report compulsory service
  - 6 report service (entrance only)
  - 1 reports no service
- 2 Total number represented
  - 5 replies represent 609 786 individuals
  - 4 did not answer question
- 3 Attitude toward the service and supervision
  - 3 report welcome it
  - 6 did not answer question
- 4 Is service extended to families
  - 1 reports occasionally
  - 8 did not answer question

5 Increase 1920 to 1928 in number of periodic health examinations

- 2 report compulsory prior to 1920 and since
- 7 did not answer question

6 Estimated percentage unsuspectingly harboring some disease or physical defect

- 1 reports 6%
- 8 report no data

7 At what age do degenerative diseases manifest themselves

- 1 reports ages 38 to 40
- 2 report age 45
- 6 did not answer question

8 Probable result in preventing modifying postponing or curing degenerative diseases

- 2 report prolong life
- 1 reports reduce morbidity and mortality
- 6 did not answer question

9 Probable effect of periodic health examinations in increasing longevity

- 1 reports 10% increase
- 1 reports 25% increase
- 3 report increase
- 4 did not answer question

## XXV ELEMENTARY AND SECONDARY SCHOOLS

In the last ten years in my travels and talks at sectional meetings of the American College of Surgeons I have found well organized educational departments in practically every state of the United States and every Province of Canada. With few exceptions primary schools and authorities in higher education are careful to note the physical well being of pupils. It is an exception

if the authorities do not insist upon vaccination against smallpox examination of the throat tonsils hearing and eyesight. As an authoritative statement on this subject I herewith submit an analysis of our survey which summarizes the activities of the health authorities of eight cities of the United States with a population of not less than 50,000 each.

Questionnaires sent 13

Replies received 8

1 Are medical service and supervision provided to students

5 report compulsory with all students

1 reports optional with all students

1 reports compulsory (entrance only) with all students

1 reports optional (entrance only) with all students

2 Total number of students 2308349

3 Attitude toward medical service and supervision

7 report welcome it

1 report welcome ( $\frac{1}{3}$  refuse mainly Christian Scientists chiropractors etc.)

4 Increase 1920 to 1928 in number of periodic health examinations

41% average increase

3 did not answer question

5 Estimated percentage unsuspectingly harboring some disease or physical defect

50% average

1 did not answer question

## XXVI INSTITUTIONS OF HIGHER LEARNING

Questionnaires sent 13

Replies received 4

1 Are medical service and supervision provided to students

4 report yes

2 Total number of students 51370

3 Attitude toward medical service and supervision

4 report welcome it

4 Increase 190 to 198 in number of periodic health examinations

225% average increase

2 did not answer question

5 Estimated percentage unsuspectingly harboring some disease or physical defect

1 reports 50%

1 reports many

1 did not answer question

6 Probable effect in increasing longevity

1 reports increase life 10 years

2 report great benefit

1 reports increase life 10 to 15 years

## XXVII EMPLOYEES OF CITY AND STATE HEALTH DEPARTMENTS

Questionnaires sent 26

Replies received 16

1 Are medical service and supervision provided to employees?

9 report no medical service

7 report yes

2 Total number of employees approximately 5000

3 Attitude toward the service and supervision

6 report employees welcome it

2 report employees tolerate it

1 reports employees prefer own physician

7 did not answer question

4 Is service extended to families

9 report never

3 report only when requested

4 did not answer question

5 Increase 1920 to 1928 in number of periodic health examinations

1 reports 37%

2 report 100%

1 reports 500%

12 did not answer question

6 Estimated percentage unsuspectingly harboring some disease or physical defect

1 reports 3%

1 reports 10%

1 reports almost all

13 did not answer question

7 At what age do degenerative diseases manifest themselves

1 reports ages 35-40

4 report ages 40-45

1 reports age 50

1 reports ages 40-60

1 reports ages 55-60

8 did not answer question

8 Probable result in preventing/modifying postponing or curing degenerative diseases

1 reports questioned the value

8 report beneficial

report postpone

1 reports 60% improvement

4 did not answer question

9 Probable effect of periodic health examinations in increasing longevity

12 report great benefit

4 did not answer question

## XXVIII ESTIMATED INCREASE OF DEMAND FOR EXAMINATION

A questionnaire was sent to several groups of leaders in the profession and the replies were most impressive.



- 371 questionnaires to Fellows of the American College of Physicians (born 1881-1890)  
 276 questionnaires to Fellows of the American College of Physicians (born 1875-1880)  
 189 questionnaires to Active Members of the Association of American Physicians  
 5 questionnaires to Emeritus Members of the Association of American Physicians  
 5 questionnaires to Associate Members of the Association of American Physicians  
 80 questionnaires to General Practitioners (selected at random) in towns of 10,000 or less

Question No. 1. In your own practice what is the percentage of increase (between years 1901-1908) in the number of periodic health examinations of apparently healthy individuals? There were 254 replies; the largest proportion from the younger group of physicians. A definite percentage of increase in number of examinations as reported by 189:

54 report from a slight to 15% increase

41 report from 15% to 40% increase

8 report from 50% to 90% increase

18 report 100% increase

25 report from 100% to 500% increase

5 report from 800% to 1000% increase

1 reports 2875% increase

15 report very much greater percentage

38 did not reply specifically

8 report not in practice 19 report no increase

Question No. 2. Among apparently healthy individuals thus examined, what percentage were unsuspectingly harboring some form of disease or physical defect?

61 did not answer question

1 reports questionable

9 report none

10 report few

88 report from 1% to 20%

8 report from 21% to 45%

5 report from 50% to 70%

24 report from 75% to 95%

7 report 100% 1 reports large number

Thus to summarize these two tables we discover that there is a growing interest in periodic health audits on the part of apparently healthy laymen, women and children.

The questionnaire also exhibits our profession's wholesome interest in this subject. With better facilities furnished to the general practitioner through our Health Inventorium and the increased demand for periodic health examinations on the part of the public, this preventive measure for conserving health and life will make notable progress in the next few years.

Briefly we note by the questionnaire Question 1 that there has been an increase between the years 1920 to 1928 on a conservative estimate of reports of approximately 1% to 1000% in examinations of apparently healthy individuals. By Question 2 that of the individuals examined who were apparently well from 1% to 100% were harboring unsuspected disease.

### THE CURABILITY OF THE DEGENERATIVE DISEASES

The diseases of middle life and advancing age already referred to are now attracting the attention of scientific medicine. What are they? At what age do they manifest themselves? Can they be postponed by thorough periodic audits? If they exist, can they be influenced by curative measures? And can the average limit of old age be advanced by careful surveillance and scientific management?

These questions are important, not only to the scientific practitioner of preventive and curative medicine, but to every person, whether of early middle or advancing life, 33% of whom at the present time succumb unnecessarily early and in the interval between birth and death suffer needless ills that destroy the pleasure of whole some and healthful existence. In the second part of our questionnaire to this same group of practitioners, this subject was dealt with most interestingly by 228 doctors who honored us with replies.

Question No. 1. In your experience at what age do the degenerative diseases of old age manifest themselves?

30 replies were recorded

1 reports late teens

1 reports ages 15 to 45

2 report 30+

93 report 35 to 45

84 report 45 to 50

34 report 50 to 60

8 report 60 to 65

1 reports 75

1 reports questionable

3 report not matter of years

1 reports distinction between male and female ages 40 and 50 respectively

1 reports distinction between whites and negroes ages 46 and 40 respectively

The range of years for the development of degenerative diseases from 15 to 75, with a large preponderance from 35 to 50 years.

Question No. 2. What would be the probable result in preventing, modifying, postponing or curing degenerative diseases of advancing age if

each individual would have a yearly or more frequent examination and supervision?

216 replies were recorded

73 report much good accomplished

66 report modify and postpone (of these 30 included cure and 40 prevent)

35 report prolong life increase efficiency

6 report no benefit

15 report fair

13 report very little good

8 report questionable

These 16 replies from the same group most of them the leading picked physicians of the United States indicate a very great interest in degenerative diseases and a belief that their course could be modified and postponed through these examinations

Question No 3 Probable effect in increasing longevity

32 replies were recorded

79 report increase life 10 to 20 years

4 report excellent

1 reports excellent after one generation

79 report marked increase

57 report some increase

9 report question the effect

1 reports no increase

2 report inheritance important factor

Question No 4 Do you advise your patients to submit themselves to periodic health examinations?

241 replies were recorded

20 report yes

13 report occasionally

8 report no

#### SUMMARY OF REPLIES FROM TWELVE ORGANIZED CLINICS

Questionnaires sent 23

1 replies received 12

1 Percentage of increase in periodic health examinations 1920-1928

1 reports 500%

1 reports material

3 report 100%

3 report 25%

2 report 10%

1 reports none

1 did not answer question

Estimated percentage harboring some disease or physical defect

1 reports astonishingly high

1 reports 100%

1 reports 85%

3 report 50%

2 report 20%

1 reports 10%

2 report 5%

1 did not answer question

3 Approximate age when degenerative diseases manifest themselves

From 35-60 mostly 45

4 Probable result in preventing modifying postponing or curing degenerative diseases

5 report prolong life

3 report prevent modify postpone

report fair

did not answer question

5 Probable effect in increasing life

10 report prolong life from 4 to 10 years

1 reports prolong life many years

1 did not answer question

6 Does your clinic advise periodic health examinations

9 report yes

1 reports occasionally

1 reports no

1 did not answer question

#### FINAL SUMMARY OF OUR INTERPRETATION OF THE FIGURES OF THIS INCONCLUSIVE SURVEY AND RESEARCH

(a) Estimated number of periodic health examinations of apparently healthy individuals—in 1920 5 000 000 in 1927 25 000 000 (b) One third of the deaths in 19 5 (or 502 083 deaths) are attributable to degenerative diseases of middle life and old age (c) Degenerative diseases manifest themselves at average age of 45 years (d) 236 replies from eminent internists and 18 replies from general practitioners indicate yearly examinations would modify and postpone the degenerative diseases and increase longevity and the maximum old age limit (e) 35% of apparently well individuals receiving periodic health examinations are found to harbor some form of unsuspected disease or physical defect (f) 90% of our replies from internists and outstanding clinics reveal that patients are advised to submit to periodic health examinations (g) Labor in industry employes in governmental and civic organizations pupils in elementary and secondary schools colleges and universities practically all receive and welcome some form of personal periodic supervision advice and service and at least 17 500 000 receive complete periodic examination service and an estimated additional 3 000 000 men and women not included in the above brings the grand total to 20 500 000

The above figures while not conclusive indicate the enormous interest that is developing

in the subject of periodic health examinations. However, this is not a guarantee that all of these examinations now are to the highest degree comprehensive and efficient. The figures do indicate the lay public's receptivity to this important innovation. And their acceptance of the ministrations of scientific medicine places upon the profession a responsibility that should induce us to give a one hundred per cent service.

### XXX CURATIVE MEDICINE AND SURGERY

Each lay elective surgery alone—with early operations for cancer, goiter, prostatic degeneration, appendicitis, spinal, cerebral, biliary, gastric and infectious diseases—is extending the lower limit of longevity and restoring invalids to healthful living.

Given opportunity to examine individuals before disease is suspected, curative medicine, with its aids in diagnostic precision and its therapeutic accuracy, is keeping people well, curing the sick, and daily adding to the wholesome of life living and the span of life.

### XXXI THE INFLUENCE OF THE PHYSICIAN IN GAINING CO-OPERATION OF THE PUBLIC

A mistaken policy of silence and a tradition of non-communicability in discussing the health problems of our patients has militated against our full influence with the public. No profession, not even the ministry, can more effectively guide a large proportion of the community on a private or public policy. When we fail to exert this prestige, it is the fault of our profession and not of the public.

We have had three outstanding illustrations of this statement.

In 1920 the irregular practitioners of the healing art, the patent medicine venders in California, backed by subsidized newspapers, attempted to prevent animal experimentation in the teaching of medicine within the state. The scientific medical profession was aroused; the educated and sane people of that great state rallied to their support, and the antagonists of scientific progress were completely routed.

In 1922 a similar belligerent campaign against scientific medicine occurred in Colorado. For a time it appeared that the qualified doctors would have to forfeit those requisites which are indispensable to the teaching of their profession and that the legislators of an important state were to turn thumbs down on the progress of civilization. Again the scientific medical profession was aroused; it exerted its influence, took the public into its confidence, told them the facts

obtained their co-operation, changed the tide toward sanity and common sense, and completely routed the opposition.

In 1911 Massachusetts, indifferent to the growth in its midst of the most subtle forms of irregular practices, found these same cults who repudiated the conventions of civilization and considered themselves strong enough to terminate the teaching of scientific medicine. They were organized to stop animal experimentation in the teaching of medicine. Slowly but eventually the profession of scientific medicine was aroused—they gained the co-operation of their patients and together they routed the Knights of Unrighteousness beyond redemption.

The profession of medicine exerts a powerful influence and can, if it will, convince at least 75% of our people that it is their inalienable right to be kept well and that the scientific medical profession is the one authentic, accredited and competent agency equipped to keep them well so far as humanly possible.

Lay people in the majority are waiting for us to take the lead in the practice of the healing art, to halt our mysterious method and let them face to face facts and guidance so that they may be maintained in good health.

### XXXII GENERAL SUMMARY

1. The profession of scientific medicine organized before the advent of Christianity is the eldest of learned professions. Spiritually, morally, and scientifically, in all civilized countries, it is outstandingly the recognized authority in the prevention and cure of disease. Like the great religions of the world, it recognizes no geographical or political bounds, but unlike the great religions, scientific medicine has no competitors. It is the one authority recognized by all civilizations.

2. For centuries scientific medicine was practiced as an art and every scientific truth employed to make its authority more worthy and reliable. With the development of the exact sciences, it has strengthened its art and made more definite its authority and accomplishment by appropriating the proved truths of modern science until it is now known and properly so, as the science of medicine.

3. As we have shown, problems of disease once after another have been and are being conquered, and not only the trained physician has this knowledge, but the educated layman too is prepared to accept preventive and curative scientific medicine as the recognized authority and rapidly the public is improving the opportunity

to keep fit and submit to periodic surveillance by the practitioner of scientific medicine

4 The thorough physical examination of millions of soldiers in the Great War proved the value of scientific medicine and convinced millions of men of the wisdom of a periodic physical audit under the supervision of scientific medicine to keep themselves well. Through systematic propaganda advocating preventive medicine to conserve personal health the general public has become aware of the value of periodic health examinations. Labor has been convinced of the value of keeping well and the industries as an economic asset have been induced to establish scientific facilities to keep their employees to the highest degree in good health.

5 Change of opinion has been wrought in the minds of the laity in their attitude toward the relative wisdom of periodic audits to preserve health rather than to wait for illness to make evident a possibly incurable condition. A whole new evolution in the practice of medicine is resulting and it promises to become a boon that will preserve personal health to the maximum and afford satisfaction to the scientific practitioner of medicine because of ability to practice his profession with greater precision and success.

6 The American College of Surgeons has occupied an important position in this movement which must command the support of the teachers of medicine, the practitioners of medicine, the authoritative societies of medicine, the journals of medicine and through all dignified means of publicity it must educate the public to the necessity of co-operation with scientific medicine if they are to be protected from illness and if the happiness of their lives is to be enhanced.

7 Statistics show that 25 112 309 individuals in the United States are employed in industrial occupations. According to our limited survey one half of these individuals receive medical service and periodic supervision conservatively we estimate that of the total employed only one fourth receive this service or 6 278 077.

In the U S Army Navy and Marine Corps 50 188 of their personnel receive this thorough service which is extended also to the members of their families. On the basis of four members of each family this brings the estimate to 1 000 752.

There are in the elementary and secondary schools universities colleges and professional schools (continental United States) 27 381 816 pupils and instructors. Our survey shows that three fourths of these receive medical service and periodic supervision but conservatively we estimate only three eighths or 10 268 181.

## SUMMARY

Individuals in industrial occupations who receive complete medical service and periodic supervision (estimated)	6 78 077
U S Army Navy and Marine Corps and members of their families (estimated)	1 000 752
Pupils and instructors in elementary and secondary schools universities colleges and professional schools of continental United States (estimated)	10 268 181
Further it is estimated that an additional 3 000 000 men and women not included in the above receive complete and thorough periodic health examinations	3 000 000
Total in these four classifications who receive medical service and periodic supervision (estimated)	20 54, 010

8 Through our recent research and study with the industries labor insurance indemnity companies governmental state county and civic authorities our universities colleges high schools and primary schools and others in their preventive health activities from our direct questionnaire to our most influential practitioners of medicine there is convincing evidence that the public is rapidly accepting the policy of co-operation with scientific medicine and the practitioner of medicine is more and more willing to do his part all of which offers conclusive proof that within the next ten years the momentum of this evolution will find 30 000 000 of our people accepting the program of yearly health audits to conserve personal health as readily as they now accept the protection provided to the masses by public health activities.

9 The health inventory—which brings into the strong trinity of co-operation the scientific medical practitioner the standardized hospitals and the laity—when thoroughly understood and accepted will insure to every practitioner adequate facilities to make thorough examinations and to the public a thoroughly reliable service.

10 The questionnaire to internists and general practitioners reveals a keen interest in observation and study of the insidious diseases of middle and advancing age—the degenerative diseases and most of them have expressed the definite opinion that yearly or semi-yearly health examinations will reveal these diseases in their incipency afford opportunity to modify and postpone the progress of many of them and definitely prevent the development of some of them. Inasmuch

as one half of our yearly deaths are attributable to diseases which reap their harvest in man's years of greatest usefulness the significance of this authoritative information is apparent.

11 This review of the evolution of the progress of clinical medicine and surgery emphasizes our responsibility as practitioners of medicine. We must give service to the utmost of our ability and with the lay public must rest the responsibility of accepting it. Volunteer acceptance of this program will

- (a) Preserve rather than restore the health of 100% of the people to the greatest degree possible through the sciences.
- (b) Require that practitioner of medicine be educated in the basic sciences before they may be licensed to practice the healing art.
- (c) Make readily available to medical schools all facilities necessary to teach scientific medicine and to preserve modern research methods in the laboratories by animal experimentation.
- (d) Employ all dignified publicity methods guided by scientific medicine to enable the public to recognize the reliability of scientific medicine and to distinguish it from the subtleties of uneducated pretenders and imposters.

12 Alas this review estimates that approximately one fourth of the laity are now indifferent to the benefits of scientific medicine and that approximately another one fourth are antagonistic to it. The victims of septsists, quacks and other unscientific practitioners. While this affects detrimentally the individuals of adult life whose wisdom should guide them to choose judiciously and with whom it is futile to protest, unfortunately it also affects their innocent children and dependents and results in much unnecessary sickness and many premature deaths. The increased health rate and the number of lives saved in 25 years of this century by the application of scientific medicine proves that the refusal of this large propor-

tion of our people to accept our aid without doubt accounts for much unnecessary illness and suffering and at least 17,581,2 preventable deaths each year.

13 More than two thirds of our people morally and spiritually favor the 18th Amendment to the Constitution of the United States. In spite of the injudicious administration of this 18th Amendment which has resulted in an orgy of law breaking of self indulgence and ridicule on the part of the other one third of our citizens the foundation has been laid for a demonstration of race betterment and extension of life that will astonish the world.

14 It is my wish that this review may aid to convince the people that one half day each year should be set aside for a comprehensive health audit of each member of every family. As physicians we know the essentials and the detail of scientific medicine. We believe that the layman and woman from childhood should have a convincing knowledge of the essentials of preventive medicine. This knowledge must be imparted by dignified publicity methods by teachers who are educated physicians.

15 Speculation though not conclusive is interesting. If this reasonable program is accepted and acted upon (and the present attitude of the people indicates that it is being accepted and adopted) based on our comprehensive survey I venture to predict that accurate statistics will record an extension of longevity from an average of 58 years in 1920 to 65 years in 1930, extension of middle age (40 to 70 years in 1920) to from 45 to 80 years in 1930 and a postponement of senility and extension of the average old age limit from its present average of 90 years to 100 years or more in 1940. And what is of greatest importance periodic health examinations with the resulting decrease in preventable illness will add immeasurably to the wholesome ness and happiness of more than 100 millions of people in the United States and Canada.



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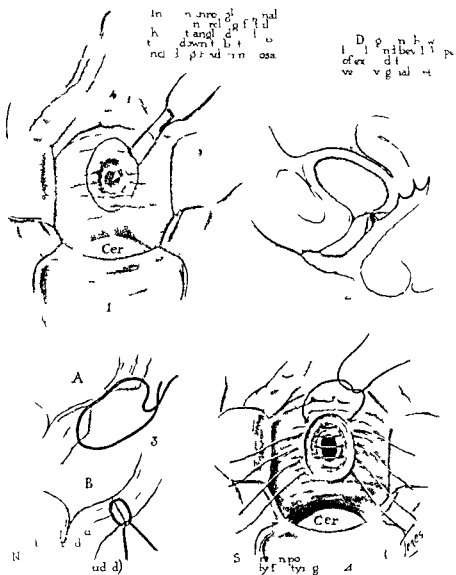
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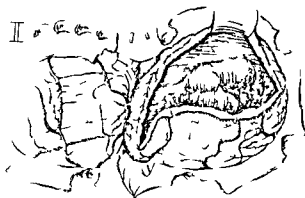
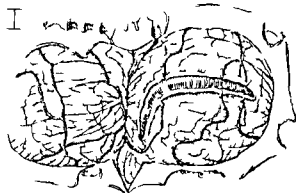
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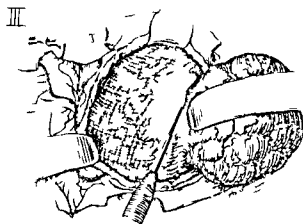
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AN INTERNATIONAL MAGAZINE PUBLISHED MONTHLY

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NUMBER 1

By HARVEY CUSHING MD FACS 10/1/77

WITH A PRELIMINARY NOTE ON A NEUROSURGICAL CURRENT GENERATOR BY THE

THE apparatus here described has been developed with the idea of making instantly available to the surgeon the various kinds of currents which have proven most useful for his purpose—delivering them through a single lead into operating instruments of practical design. No use is made of electrically heated cauteries, wires or calpels. The effects obtained depend entirely either upon the heat developed by the current in passing from the active electrode into the tissues or upon the ohmic heat developed by the current in passing through the tissues.

As is well known comparatively large amounts of an alternating current of the frequency of the alternations is sufficiently high can be passed through the tissues without producing any physiological effect other than that of heating. The amount of heat developed by a high frequency current is proportional to the square of the current density.

In electro surgery a high current density is obtained by making the active ( operating ) electrode small whereas the inactive ( indifferent ) electrode through which the electrical circuit between the patient and machine is completed is made large so that the current density in its immediate vicinity will be sufficiently low to permit the small amount of heat developed to be readily dissipated by the blood stream.

For certain purposes, as in the original description, the electrode can be entirely cut being made by the machine. Under the patient's body, the charged with each and with the amount of the electrode into an efficient to produce

This preliminary place for a discussion of the various current principles involved in currents used from one to three distribute themselves in a manner very different from the currents or alternating frequency such as in a power line circuit. The voltage and amperage currents and for a frequency are in terms phase shift served if instead the physical change catalogue of the effects on tissues

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There are three distinct ways in which the various high frequency currents delivered by the Unit are used in electro surgery (1) *superficial dehydration* (2) *cutting* (3) *tissue coagulation*

1 For *superficial dehydration* the active electrode is held not in actual contact with but sufficiently close to the tissues to be dehydrated so that sparks are sprayed across the intervening space. The very high temperature of the sparks is sufficient completely to dehydrate a thin outer layer of tissue.

For *cutting purposes* the active electrode is energized by a different type of current. The cutting is not done by the electrode which has no sharpened edge but actually by the current which forms ahead of the electrode an electrical arc which by volatilizing the tissues separates them as though they were cut. Further by a suitable modification (variable amount of damping) of the same current a greater or a lesser degree of coagulation or dehydration may be produced at will at the edges of the severed tissues. When the tissues are not particularly vascular the current is so modified as to produce the minimum amount of dehydration but when the blood supply is greater the amount of dehydration is correspondingly increased.

The apparatus is provided with control switches so that the active electrode can be instantly energized with the particular kind of cutting current which the surgeon requires. For sometimes he wishes a strong current to make deep incisions rapidly at others weaker currents by which delicate bloodless dissections may be carried out.

3 For *heating the tissues en masse* (the so called electro coagulation) the kind of current used differs widely from that employed for cutting. An electrode energized with coagulating currents instead of having cutting properties cannot be moved through the tissues. The tissues surrounding the electrode become heated to a depth depending on two factors the density of the current and the length of time it is permitted to flow. If a large tissue mass is to be coagulated a comparatively weak current must be used for a prolonged period until it becomes heated throughout. For should a stronger current be used the

tissues in the immediate vicinity of the active electrode would become so quickly dehydrate or even carbonized that the current would cease to flow and the deeper tissues would not be effected. If on the other hand a small tissue mass is to be coagulated one uses a strong current for a brief length of time so that surrounding tissues are not affected.

It has been sufficiently emphasized in the foregoing paragraphs that the usefulness of this electro surgical unit lies in the possibility it offers of varying at will the character of the cutting current so as to secure different degrees of dehydration.

*The apparatus* The usual electro surgical apparatus is provided with a foot control for turning on and off the current. But since it has been found in practice that a foot control limits the surgeon too much to one position a convenient hand control has been added. This not only gives the surgeon increased freedom of movement but greatly facilitates his coordination.

Because of its shape the hand control has become known about the laboratory and hospital as the pistol grip. It consists of a special handle designed to hold the operating electrode the current being under the control of the surgeon's index finger which presses a small trigger. A number of operating electrodes have been constructed for special purposes all of them interchangeable in the pistol grip. For obvious reasons such accessories as retractor and so on which the surgeon needs to employ in the operating field should be constructed out of insulating materials.

#### NEUROSURGICAL EXPERIENCES WITH THE BOVIE UNIT (HARVEY CUSHING)

The surgery of intracranial tumors has grown from its small and unsatisfactory beginnings to a specialty of unquestioned importance. Tumors of the brain of one sort or another are extremely common and as experience accumulates they are coming to be treated with increasingly favorable results. Such notable progress indeed has been made in recent years that the dismal attitude regarding these operations widely held at the turn of the century has gradually been

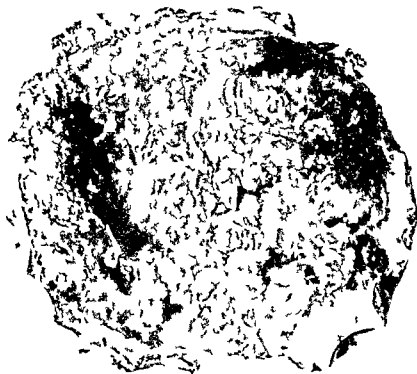


Fig. 3. External surface of remaining block of tumor with inclined bone removed with subjacent dura at the third session.



Fig. 3.4. Case 1. The patient on discharge, 45 days after operation.



During this two years period we have with growing confidence come to utilize electro surgical methods for increasingly difficult surgical problems and have even sent for old patients who have either been refused operation in the past or whose tumors on exposure have been regarded as inoperable. In all of this we have undoubtedly increased our operative mortality for the sense of security due to the vast improvement in the technique of hemostasis which electro surgery makes possible has led us into undertakings that would have been foolhardy to say the least in other days.

By no means does the introduction of this adjunct to craniocerebral surgery mean the entire abandonment of the established principles of osteoplastic intracranial procedures. It is chiefly revolutionary in that it enables the surgeon to excavate the central portion of many tumors particularly those that are encapsulated with greatly lessened bleeding so that the growth may be collapsed and its shell more safely and with less contusion than formerly be brushed away from the enveloping brain. This is no new principle to be sure for it has been long applied in the intracapsular attack on the tumors of the cerebellum at the angle that arise from the *Acrus acusticus*. But it has been far less commonly utilized for the removal of other tumors it having been the surgeon's ideal to remove the growth when possible intact rather than in separate fragments owing to the risk of inoculation of the field by tumor cells which the piecemeal method favors. But when the electro loop is used for the purpose the risk of sowing viable cells is negligible.

These principles of primary intracapsular enucleation by electrical methods apply more obviously to the treatment of the meningeal tumors which were among the first to be successfully though in the beginning somewhat crudely attacked. They consequently deserve primary consideration and the case



Figs 56 Sympathicoblastoma before and after its electro surgical removal. Pre operative diagnosis meningioma, sarcoma or myeloma.

reports may well be restricted to our experiences in the spring of 1927 as they are more likely to illustrate technical errors and accidents that have since come to be largely avoided.<sup>1</sup>

**The Meningiomas** From the standpoint of their relative benignity these of all intracranial tumors are regarded as the most favorable for operation. However they often attain a huge size before they are recognized their environment is apt to be excessively vascular their attachment to one or another of the large dural sinuses supplies an element of especial danger and if the area of attachment is not removed a recurrence is inevitable. They often arise in inaccessible regions of the base of the brain and even when more favorably situated their removal intact is likely to be followed by cerebral edema and by circulatory disturbances on the part of the cerebrospinal fluid that delay convalescence. Hence they are possibly in the long run the most difficult of all tumors safely to attack and completely to remove without secondary complications.

The meninges are composed of three layers, the dura mater, the arachnoid, and the pia mater. The dura mater is the outermost layer and is composed of two layers, the outer layer and the inner layer. The arachnoid is the middle layer and is composed of a single layer. The pia mater is the innermost layer and is composed of a single layer. The meninges are located within the skull and surround the brain and spinal cord. They are responsible for the production of cerebrospinal fluid and for the protection of the brain and spinal cord from infection and injury.



Encouraged by the technical success of these operations we began step by step with Dr. Bovie's moral support to engage in the more serious business of attacking tumors that lay wholly within the cranial chamber. We were of course dealing with a novel procedure and were utterly ignorant of the immediate physiological or remote pathological effects that might be produced by electrical dehydration or charring of the nervous tissue.<sup>1</sup> Many shifts and adjustments from our customary methods of procedure were found to be necessary but we fortunately avoided any serious accidents other than an occasional infection which crept in to mar our generally irreproachable wound healing. These few infections were due as we have since learned to faulty technique rather than to any lowering of the resistance of the tissues to which we at first were inclined to ascribe them.

The whole question of the anæsthetic had to be carefully reviewed for though most intracranial operations today are carried through under local anæsthesia a supplementary inhalation narcosis may sometimes be necessary if the patient is mentally uncooperative or made physically uncomfortable. On certain occasions in the course of prolonged operations the body became so heavily charged that the anæsthetist on accidentally touching the patient's face could get a spark which might well enough have caused an ether explosion under the hood. Only once however did anything of this sort occur. It was a case in which a small opening had been made into the frontal sinus in the course of a transfrontal osteoplastic operation. This led to a direct communication between

the respiratory passages and the field operation and suddenly the ether vapor sparked and went off in a blue flame for a moment without any injurious effects. This experience however was sufficiently disconcerting to lead us for a time to substitute for inhalation narcosis the rectal administration of ether to tide patients when necessary over the more uncomfortable period of a prolonged session.

Other difficulties experienced at the outset were due to the fact that epileptiform attacks were occasionally produced (cf. Case 6) when the electrode was used to check bleeding from the surface of the dura. For though these high alternating currents are not supposed to have any stimulating effects on irritable tissues apparently under certain circumstances they could become so diffused from the point of discharge that their overtones were capable of producing physiological responses and a Jacksonian fit or a convulsion in the course of an operation when the dura is open may lead to serious consequences.

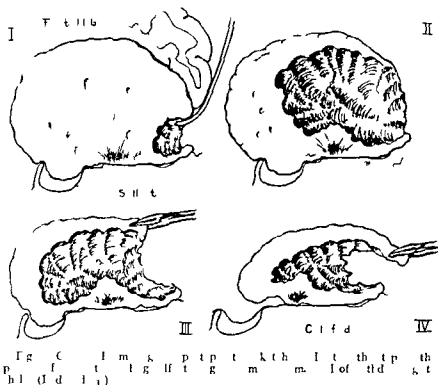
We were also troubled at the beginning by the tendency of the current to become grounded through the table through the metal retractors and so on. Once the operator received a shock which passed through a metal retractor to his arm and out by the wire from his headlight which was unpleasant to say the least. On another occasion (Case 4) owing to the improper application of the indifferent electrode during a prolonged operation a second degree electrical burn was produced which was slow to heal. Some of these complications were due to inexperience some of them lay at the door of the apparatus itself and we were temporarily forced to employ a wooden table, wooden patulae and so on but one by one the difficulties have been wholly eliminated by progressive modifications in the design of the current generator. Further improvements will unquestionably follow but as things now stand those who come to use the apparatus will be spared from much that we have gone through and will find it possible without risk to utilize their ordinary operating table equipment and customary methods of procedure.



FIGS 9-10 Case (Left) Photograph of the patient on her discharge showing the inconspicuous scar and the slight residual palsy of the right third nerve which had been continued during dislodgment of the posterior fragments of the growth. (Right) Photograph a year later to show recovery of the third nerve palsy and inconspicuous scar.



FIG 11 Case Photograph of such fragments of the tumor as were preserved. The large partly excavated block of the growth shown on the right lay wholly to the left of the falx and was the last fragment to be dislodged (cf FIG 8).



Fortunately however the most serious of all postoperative complications namely a wound infection with secondary meningitis has long been wholly eliminated and consequently when a fatality from an infection followed the prolonged use of the current in our first case we were greatly disheartened even though there were extenuating circumstances. The tumor which had been unsuspected was an extremely large and

capable of combat, a mild infection as to have been responsible for the patient's death from meningitis nine days later.

As chance would have it soon after this disheartening experience with the primary excision of a meningioma in the manner mentioned two patients entered the hospital at almost the same time each of them with a large subfrontal tumor originating from the meninges of the olfactory groove. The account of the operation on the first of these patients (Surgical No. 8026) was made the basis of the Macewen Lecture<sup>1</sup> some five months later and the report of the other may serve our purpose here to illustrate the method of procedure.

CASE. The patient (Surgical No. 28046) was married 36 years age 40 had a fairly typical olfactory groove syndrome. Following an injury five years before her admission she began to appreciate a diminution in the sense of smell which soon became wholly lost. Of late she had been having recurrent attacks of numbness and stiffness in the left side of the face suggestively Jacksonian in character. There was evidence of loss of memory and her relatives were aware of disposition changes.



I g C I t f g m t f t m t b d  
l d d f o m l f t f t l l b d w t h d f m u l  
d d d f a l N t h t t d l u f o f  
b l m g o m t h t a t

C h m H Th m f m f m h l t y f c l  
P 11 L N 53 p p f 1 L J 5 7 39



FIG. 12. Case 3. To show on median section a large symmetrically placed olfactory groove meningioma the left half of which had been attacked by electro-surgical methods which proved ineffective from the excessive vascularity of the lesion.

be abandoned owing to excessive bleeding from the surface of the excavation.

The case was given up as surgically hopeless and recourse was had to radiation which accomplished nothing. Mental symptoms became progressively more pronounced during the succeeding 8 months and on the bare chance that the lesion might be amenable to electro-surgical methods it was again attacked on March 8, 1927. At this time in the course of a nine-hour operation wholly under local anesthesia the chief mass of the growth to the left of the falx was thoroughly scalloped but interstitial bleeding in the depths became increasingly difficult to control and withdrawal with a transfusion was necessary. On the following day we were forced by undue bulging of the flap to re-elevate it and to remove by suction a sufficient amount of the infiltrated and dislodged growth to restore normal tension but bleeding was started afresh and in spite of another transfusion he succumbed some 12 hours later.

At autopsy it was found that only the left half of the large growth had been in large part removed. The median section of the brain shows (Fig. 12) the dimensions which one of these tumor growths may attain.

Our experience with electro-surgical methods was wholly insufficient at the time to enable us to deal with such a highly vascular and formidable lesion. Bleeding was if anything accelerated rather than checked when the attempt was made to coagulate the raw surface after removal of each scallop of tissue for the growth was soft and the charred surface tended to cling to and come away with the electrode.

The growth nevertheless might possibly have been removed without undue difficulty in 1924 when it was first exposed had it been approached from the right rather than the left side had we uncovered the tumor more fully by removing the overhanging shelf of the frontal lobe and had we known at the time that the vascularity of such a lesion could be reduced by the slow process of surface coagulation before its piecemeal extirpation was begun.

Obj: the lvs were nothing to show except a complete anopia and bilateral papilledema of low grade. A slight enlargement with erosion of the sella turcica and a minute area of calcification to the left of the midline just above the olfactory groove slightly below the crista galli were apparent on the scolopendromograms.

O T u l r y 15 19 u r n o v o c u r i n a e s t h e s i a  
t h u l r i g h t i n t l s t e o p l a s t i c f l a p s r f l c t e d  
t t l s i d l i v g b i r e a n e x t r e m e t e n s e d u r a A n  
u n c f u l a t t i m p t w a s m a l t o e m p t y t h e v e n  
t l t h p u n c t u r e n e c l e e n c u n t e r i n g a l a r g  
r i s t a t t u m o r t h e d p h t s T h e t e n s i o n a s s o  
g t t h a t t v a i m p i b l t o e l c a t t h e f r o n t a l  
l u a f m t h b t l p l a t i n o r f r t o g e t t o t h e  
t t h t u m r b t f o r e o p e n d t h e m e m b r a n e  
I h g t i n t w i s t h r f o r g e n a n i n t r a v e n o u  
i n j t t f h p t o n i a l n h h p r m p t l y r e  
l u t t s u i t t o p e r m i t t h e d u r a t o b e

to b a a ad n d t ge f pr ssure abs rption  
Th und r u f h f th frontal lobe was then  
cl t r and lru h a y from th gro th until  
it l v r dg was ll enough expo d so that  
s llops t th tisu could be scooped out with  
th lectric fl p \ uff iciently d ep furro v was  
thus made t let th patula le ator be inserte l  
u d r its upper e l g a to over ome the tendency  
f th ten brain to extrude into the wound (E-

I) The growth is then activated still further until the shell of that part in which lay the right of the valve could collapse and withdrawn in the manner shown (Fig. III-IV).

The o l y n i l f r l a n t i n t h i s t h o u s r  
f m h n w a u s d b y a s h i a r t a l h a m o r r h a g  
h h f l l y l t h l l l g m t f t h p t e r i  
d u l o f t h g t h w h i h o v r l y t h p i t u t a r  
f o a B u o f t h g r a n d p t h o f t h a v i t y  
t h a n t m i l i t r n f t h s t r u t u r s t w a s  
l i f t i l t t l l h t v t l m h a y l n i n j u r d  
b u t t p r s u m b l y s t h n t e r r e c r b l t h  
v l a a l l l t o b l i n t o t h e s u c k e r a n d  
a f t r t o t h r u n v a i l i n g a t t e m p t s t o p e c k i t  
u p b y s i l l p t a u g h t b e t w e n t h e b l a d s  
f d i c t i n g f o p a n d b y g o d f r t u n e s u c c e s s  
f l l c o a g u l a t d l y p n s n g t h c u e n t a l o g t h  
s t u m e t I t h e f l u r f t h i p r o c l u r e i t a s  
g r a t i f a r d t h t h c h r i s m m i g h t h a v e b e e n  
o n t u c d r e c k d b y t h u r n t b u t n c l e a n i n g  
y t h c l o t t h c o m p r s d h r s m a n l n r v e s  
u l d b s c l a l y p d a d p p a r t e n t l y u n i n  
u r l

The process of removing the right-sided half of the tumor had permitted fluid to large amount to escape from the meninges in the exposed right Sylvian fissure so that tension had become wholly relieved. It is therefore possible more easily to expose a lobe to attack the equally large mass of tumor to the left of the fissure which was formerly excised than the lobe of the first moving the craniotomy.

galli and making a cross section of the falx. Finally, the remaining shell of the half of the tumor which contained the calcified area was freed from the falx. The olfactory groove dislocated out of its pocket and drawn out from under the falx in one piece (Fig. 8). As a last step the site of the dural attachment of the growth along each olfactory groove was obliterated by brushing it with the electrode with the purpose of destroying so far as possible any remaining nests of cells. The flap was replaced with drainage.

From this five hour operation during the last stages of which ether had been necessitated the patient made a perfect recovery. There was no evidence of injury to any of the exposed nervous structures apart from a temporary diplopia due to a right inner palsy on the right side (Fig 9) which had probably been produced in the process of checking the bleeding vessel. Vision remained unimpaired. She has recently been examined (Feb 14 y 15 19 88) and except for her residual anisometropia she remains symptom free (Fig 10).

The charred fragments of the tumor which were collected and saved possibly representing not more than half of the growth weighed 35.5 grams (Fig. 11).

The outcome of this operation was more satisfactory than in the similar case described in the Macwen Lecture for normal vision has been preserved. But the brilliant results in these two cases were soon offset by two other unsuccessful operations in one of which we were wholly baffled from inexperience by uncontrollable bleeding and in the other by an indolent wound infection which ultimately proved fatal. In both instances though the tumors had reached a large size with marked mental changes and near blindness the diagnosis of an olfactory groove meningioma was unmistakable. The first of the case in which bleeding got beyond our control follows.

CASE 3 A young man (Surgical No. 8338) 32 years of age sustained contusions in an automobile accident in 1918 six years before his hospital admission.

For this we attributed the symptoms of an unmistakable olfactory growth tumor to the course of time had begun seriously to affect

It was first reported upon October 10, 1941 when the lateral anterior margin of the tumor was exposed but its unusual vascularity precluded more than a fragmentary removal of tissue for fixation. As a result of the decompression led to

symptoms began to reappear. Consequently, J. H. 1966 as a consideration of the underlying factors, a larger portion of the first three sessions was removed from the first session but the operation again had to

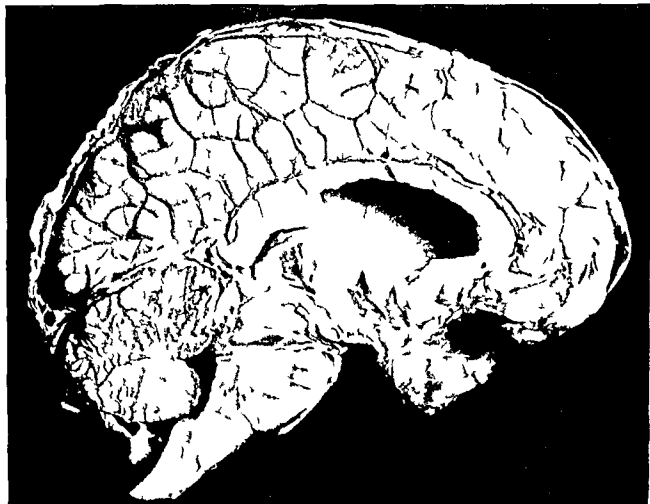


Fig 14 Case 4 Medial section of the brain showing dilated left ventricle with occlusion of foramen of Munro from suppurative ependymitis. No trace of tumor found. For comparison with Figure 1.

the tumor in the depths of the wound. The infection was unquestionably attributable to some slip in technique during the unduly long exposure of the open wound rather than to the secondary effects of tissue coagulation to which we at the time were inclined to ascribe it.

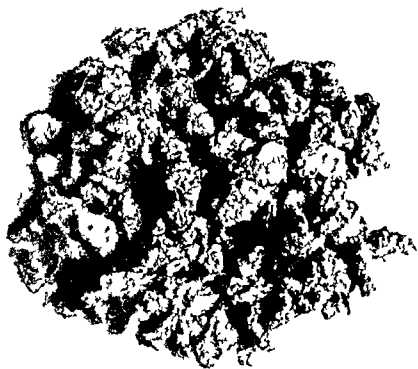
These four cases represent then our first essays to attack the large olfactory groove lesions which have been ordinarily regarded as inoperable though many surgeons have of course exposed them at operation and have removed them in part. We have since had six other wholly successful operations of the same kind some of them with total removal of tumors as large as the last described. They however add nothing more from an electro-surgical standpoint to the records given above apart from the fact that the operations owing to accumulated confidence were much less time consuming some of the more recent cases

having been conducted throughout under local anesthesia.

The discouragement produced by these two fatal operations for olfactory groove tumors recorded above had meanwhile been offset by the more favorable outcome of operations for large meningiomas in other situations less difficult of approach. One of them was a subtemporal lesion that had once been given up as inoperable as will be told.

CASE 5. The patient (Surgical No 2826) was a woman 46 years of age whose symptoms suggesting a cerebellar tumor had begun in 1920. In 1922 a subtemporal decompression had been made by a surgeon in Montreal. This relieved her headaches for a time but on their return a year later she was referred to the Brigham Hospital where one of my assistants explored the cerebellum and exposed what was thought to be a large inoperable glioma.

She made an excellent recovery and was free from further symptoms of any serious import for the



4 5

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12

13

I 3 C 4 Th ll t lf m t ( ll p) f ymm t lly pl ed lf  
t g m m m l t l th ult m t f t l t f m

The story of the other olfactory groove tumor in which a postoperative fatality from infection occurred is briefly as follows:

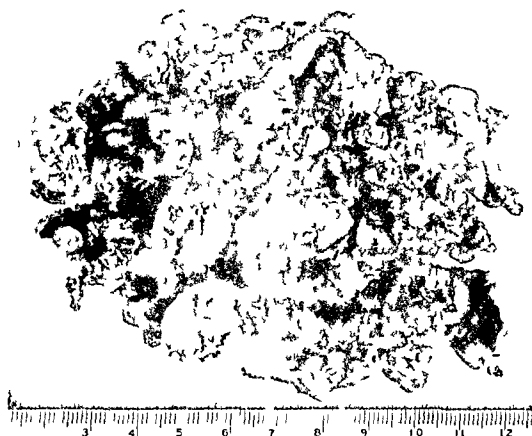
CASE 4. The patient (Surgeon No. 28344) was an obese Japanese male of age who had been partially blind from optic atrophy for 20 years and who had complete vision and divine mental hangings. The X-ray showed the typical spot of calcification in the stalk of the tumor of the olfactory groove.

At the operation on May 10, 1919, a huge growth much larger than expected was disclosed by the usual transfrontal procedure. The lesion was invaded with the intracranial loop in much the same piecemeal fashion (Fig. 13) described in the operative note on Case 3. In the process the frontal horn of the ventricle was opened and though this was unintentional the escape of fluid gave an abundance of room in which to work. The growth finally so far as could be told was removed in its entirety, the depressed chiasm and flattened optic tract being left fully exposed. The patient though in good condition at the conclusion of the prolonged eight-hour procedure, the last part of which had required

agitation and the tissues transused with 25 cubic centimeters of blood.

He made an excellent immediate recovery but unhappily the convalescence was complicated not only by a temporary but also by a permanent loss of vision. The patient remained in fairly good condition but on the spontaneous loss of vision rapidly entered a coma and finally died two months after the operation. The autopsy showed a suppurative state of the olfactory groove. No residual of the tumor was to be found (Fig. 4).

The lesion in this case was a large symmetrically placed meningioma estimated at circa 70 grams (the collected fragment weighed 51 grams) but it fortunately was not particularly vascular. The prolonged session was due largely to apprehension lest damage be done to the vessel and chiasm enveloping



F 16 Case 5. Pre crural scallops (weight 50.5 gram) of the circa 60 gram subtotal meningeoma

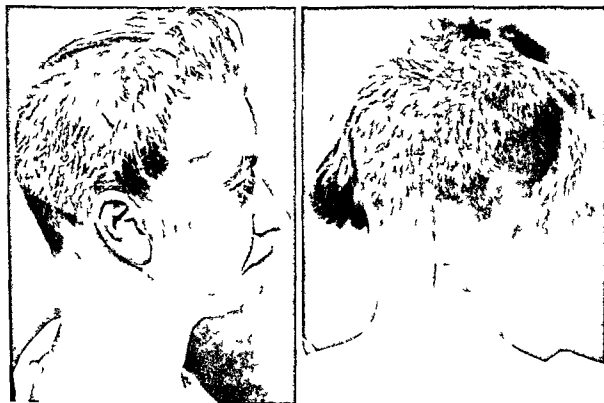


Fig. 17-18 Case 5. The patient on her discharge after operation for subtotal meningeoma to show inconspicuous scar of the usual cross bow incision



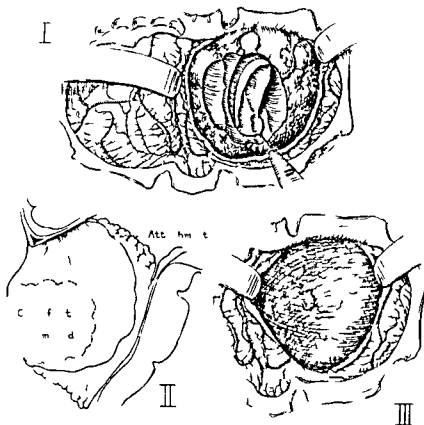


Fig. 5. C. S. I. m. th. mm. d. te. po. to. t. e. k. t. h. to. g. id.  
f. t. ion. l. t. t. f. the. l. I. Sh. s. t. m. p. cess. f. ll. p. id.  
II. p. t. e. t. befo. f. ed. ll. p. e. f. h. ll. III. c. ty. afte. f. al.  
t. p. t.

on the four a. h. n. h. ada. h. s. began to return and reb. lla. atax. a. gradually b. came. o. pronounce. l. he could not fr. l. y. get about. A. fragment. f. the tumor. r. moved. t. the op. ation. for. h. stologic. l. xam. ation. had. m. an. h. le. been shown. to. be. an. actively. growing. m. n. glioma. In. the. belief. that. the. growth. might. b. f. v. or. ble. for. remo. al. by. cl. ctro. surgic. l. m. th. d. she. a. encouraged. to. return. an. l. on. I. b. a. y. a. 19. the. cerebellum. was. agai. posed. and. un. l. r. loc. l. anasthesia. a. ci. ca. 60. gram. m. n. t. gom. v. h. h. almost. filled. th. poster. or. fossa. and. l. had. t. m. n. at. t. h. ment. to. the. lateral. sinus. a. d. l. r. su. f. c. of. th. t. ntorium. as. far. for. w. l. as. the. nci. ura. su. ssfully. x. t. r. p. at. l. p. cem. al. in. its. entirety. by. th. pro. ss. of. scalloping. v. th. the. elec. tr. fied. l. op. (I. gs. 15. nd. 16). I. h. wound. as. usual. as. clos. d. s. ur. l. v. layers. v. t. l. out. drainage. of. the. huge. cavity. Recovery. was. uneventful. and. heal. g. perfect. (I. gs. 7. and. 8) in. spite. of. the. temporary. tendency. of. the. cav. ty. to. fill. with. xanthochromic. fluid. v. h. ch. mad. an. occasional. postoperative. punc. ture. necessary.

Another case of precisely this same sort in which an exceedingly dense fibroblastic menin-

glioma had been once exposed and abandoned as inoperable has since been similarly and successfully operated upon the patient who was doing well enough as the result of the decompression having been induced nevertheless to return for another trial.

We may now pass to another far more accessible type of meningioma but one nevertheless whose very exposure may prove to be attended with exceptional risks. Possibly none of these tumors are more difficult safely to uncover than the one which takes their origin from the meninges at the outer end of the sphenoidal ridge near the pterion where the middle meningeal vessels groove or perforate the lower corner of the parietal bone. The region may be excessively vascular and even the preliminary ligation of the external carotid has little influence on the bleeding that may be set going. Moreover there are apt to be cranial endostoses that project into the core

Few operations in surgery are likely to be more hazardous to offer more technical difficulties or to put a greater strain on the judgment and resourcefulness of a surgical staff. To be sure procedures of this sort have in the past been successfully carried through by other than electro surgical methods but hardly in one sitting. The steps of the operation have possibly been given in unnecessary detail for those who have had personal experience with similar tumors and who are already aware of the difficulties. The principal reason however for including the case here is to call attention to the fact that epileptiform seizures were produced by the passage of the coagulating current through the dura and to give warning of this possibility. Fortunately the convulsions occurred before the dura was opened else they might have caused serious trouble from the accentuation of bleeding and cerebral protrusion.

To show that the successful outcome of this case was not exceptional a few weeks later the outer margin of another still more deeply situated meningioma (Surgical No. 28598) arising from the sphenoidal ridge was stumbled upon in the course of an exploration for a presumed tumor of the right frontal lobe that had been wrongly localized by misinterpretation of the ventriculograms. The *circa* 100 gram growth shown in the accompanying photograph (Fig. 25) in the course of an eight hour session including the ventriculography was thoroughly excavated collapsed and cleanly removed after which the residual dura which could not be removed on account of its dense attachment to the wing of the sphenoid was thoroughly dehydrated by spraying with the ball electrode. Recovery was perfect.

In another place and in another connection<sup>1</sup> has been described how electro surgery may be of aid not only in the primary attack on smaller meningiomas in inaccessible situations but as a means of destroying the sometimes irremovable cell nests in the adherent dura and bone. But what has already been said

will perhaps be enough to show what may be done with these particular lesions.

During the two years we have had an unusual number of meningiomas thirty nine patients having been admitted for their primary operation and twelve for a secondary operation or for recurrent symptoms. In all but four of the cases the tumor was removed in a single session with six (11.7 per cent) fatalities four of which have already been mentioned. This is a high mortality percentage but many of the operations would not have been even ventured upon at all or would have been given up in course as unduly hazardous or impossible of accomplishment by other than electro surgical methods. As four of the fatalities were due to infection it must be confessed that on this score the electro surgical methods served temporarily to increase operative risks but this of late appears to have been wholly overcome.

*The Blood Vessel Tumors.* What has been said above regarding the risks from loss of blood in dealing with the larger meningiomas applies still more to the tumors that are actually of angioblastic origin for many of them are truly formidable lesions even when attacked with the aid of electro coagulation as we soon found to our cost. On March 19 1917 the day after the successful extirpation of the large Sylvian meningioma that has been described we ventured to attack a rapidly enlarging capillary hemangioblastoma of the fourth ventricle. An account of the case has been included in a monograph which deals with the subject of the blood vessel tumors as a whole and a brief resume will suffice for our present needs. It was the first occasion in which we had used the highly damped desiccating current for the purpose of superficially dehydrating and shrinking a vascular growth before its removal.

CASE 7. After many vicissitudes from mistaken diagnoses the patient (Surgical No. 28466) a young woman of 3 years had finally been operated upon in September of 1925 at which time a large cerebellar cyst was evacuated and a highly vascular nodule disclosed in its base. An attempt to remove even a small fragment of the lesion for histological identification led to bleeding that was checked with great difficulty. She did well for a year when owing

C h g ll r v y d f h dt lo Th m g m s  
f m th t b e f m lle with l y d m f p m r y pt  
t phy d b t m p o l f d d f e c t s m b d w h r m l l l t  
m d f f g d p e s o A b O p h t h l (Ch g) vol t 9 9  
( p )

C h g l b d y T m is n g f m th blood ss l f th  
b A g m a t u m a l f m t o d b m a g blast m s C.  
Th mas sp n g f d l l l 9 8 (Cas. 22, IV)

of the tumor and should these be torn out when the flap is elevated the bleeding may at times be most difficult to get under control.

A good example of such a tumor that had progressed to a fatal issue without surgical intervention is the famous case so often referred to in the writings of Byrom Bramwell (Fig. 19). We have had a number of typical examples of the e tumors in our series some of them successfully enucleated in successive sessions but I had particular reason for being gun shy of them having had the shocking experience a little more than two years ago of losing a colleague a young Boston physician who had died on the operating table from the loss of blood caused by the mere reflection of the ragged and tumor involved bone flap which adhered to the vascular surface of the tumor. While this harrowing episode was still vividly in mind the patient whose history follows entered the clinic.

**CASE 6.** A married woman (Surgical No. 28364) 44 years of age had the classical symptoms and signs of a left Sylvian fissure meningioma associated with contralateral Jacksonian seizures beginning in the face. There was aphasia with slight right facial palsy and a right homonymous hemianopsia. The X-ray showed the typical endosteal projection to the stalk of the tumor at the outer end of the sphenoidal ridge with enormous environmental diploic sinuses and dilated meningeal channels.

Preparations were made for a critical operation with a donor prepared for transfusion and masses of petrolatum secured from a breast amputation scheduled for the same hour.

On March 18, 1919, under local anesthesia a left osteoplastic flap was outlined with some difficulty and the flap was elevated but broke off only partly exposing the highly vascular dura over the tumor. Bleeding was excessive in spite of pressure and the abundant implantation of muscle which was at hand. Since these measures were insufficiently effective they were abandoned and with the field kept reasonably dry with the sucker the effort was made to coagulate the dural vessels. This had the desired effect on the bleeding but the current caused a severe convulsion beginning in the right face and necessitating the inhalation of ether for its control. After some delay and after consciousness had been regained a second convulsion was produced by the further coagulation of the cerebral vessels and from this time the patient was kept under ether. The remainder of the tumor involved bone overlying the core of the lesion and extending down into the sphenoidal ridge was then removed piecemeal each bite of the rongeurs being followed by sharp bleeding

ing fortunately controllable by coagulation. Finally the subtemporal area of involved dura was fully uncovered.

The patient's blood pressure by this time had fallen off markedly and preparations were made for refusion of the collected blood. Meanwhile with the purpose of getting some idea of the surface extent of the lesion in anticipation of the probable necessity of a second stage performance one or two small incisions were made through the dura supposedly beyond the periphery of the lesion. On each occasion soft tumor rather than brain was exposed for the growth proved to be unexpectedly large fully ten centimeters in its surface diameter. The idea of encircling the area of adherent dura with the intent of allowing the lesion to extrude between two operative periods was therefore abandoned.

The attempted transfusion had been a failure from inability to get into a sufficiently large vein but as the pressures by this time had begun spontaneously to return the chance was taken of at last starting with an intracapsular enucleation. Accordingly with the desiccating current the dura was incised directly into the heart of the tumor from which generous scallops of tissue were successively scooped out with the electrified loop. The center of the lesion fortunately proved to be of low vascularity and the excavation was carried sufficiently far to permit of the partial collapse of it shell.

The growth was then encircled by an incision through the intact outlying dura. The chief difficulty lay in getting a free dural margin in the deeper more vascular and more inaccessible sphenoidal region without further loss of blood which the patient could hardly have stood. But the difficulty was overcome by making the dissection of the membrane between a succession of curved clamps and by sealing the severed margins with the current passed along the clamps before their removal.

The shell of the growth thus freed began promptly to extrude and it was a simple matter to collapse it as it was brushed away from the nervous tissue forming its nest such small vessels as were found to enter the surface of the growth being picked up and coagulated as the enucleation proceeded. The shell of the growth was finally dislodged from its huge pocket with scarcely any injury to the pia arachnoid the greatly enlarged and dislocated Sylvian vessels lying exposed in the depth of the cavity. While the osteoplastic flap was being replaced and the wound closed a transfusion of 500 cubic centimeters of whole blood was given. All told it was a seven hour session.

The photographs of the presered tissues (Figs. 20, 21 and 22) which weighed 128 grams and probably represented a circa 50 gram tumor together with photographs of the patient (Figs. 23 and 24) who made a prompt and uninterrupted recovery will tell all that is additionally needed to complete the story.

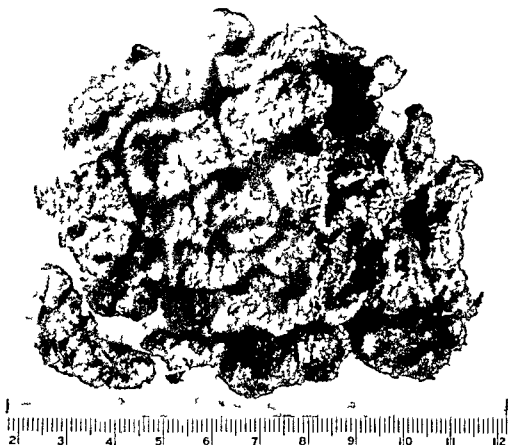


Fig. 6. Case 6. The clotted callosum so far as they were preserved that were evacuated from the heart of the tumor (cf. Fig. 21) before it collapsed permitted removal (weight 58.5 grams).

CASE 8. The patient's history (Surgical No. 28582) occurs as Case 1 in our monograph on the blood vessel tumors and it will suffice to say here that she had first been operated upon for an emergency cerebellar syndrome in 1933 the tumor not being brought to view. She had pulmonary tuberculosis and a cerebellar tuberculoma was suspected.

As a result of the decompression she did well for nearly three years. In July of 1936 at a secondary exploration a huge unmistakable hemangioma occupying the larger part of the right cerebellar fossa was exposed. Because of its vascularity it was not even possible to remove a fragment of the lesion for histological verification. From this operation she had received but little if any benefit and aware that she was rapidly losing ground she was encouraged to return.

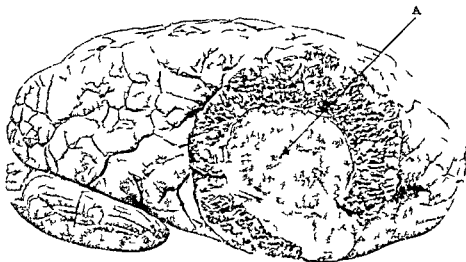
At the third operation on April 19, 1937, under local anesthesia and in spite of her highly advanced cerebellar symptoms the desperate procedure of slowly attacking the huge angiomatous growth by the process of dissection and coagulation was successfully carried through in a seven hour session with three transfusions in course.

She made all told a satisfactory surgical recovery and had it not been for her by this time advancing

pulmonary tuberculosis the prognosis would have been favorable. She died at her home from some obscure cause without autopsy seven months later.

Two other patients with a growth of precisely this same formidable sort have since been seen through with better success one of them a young boy whose tumor had been previously exposed and considered inoperable the other an adult in whom the vascular growth was successfully and radically attacked by dehydration methods on its first exposure.

We had hoped that the angiomatous malformations a discussion of which comprised the first part of our aforementioned monograph might be similarly attacked by electro-surgical methods but in the single case in which the attempt was made we had the misfortune to spark through one of the superficial vessels of the aneurysmal lesion thereby causing troublesome bleeding. With



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l d m ) f d t top y f j o t t th t f the d l e t l c o f d u a m t

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v i s d i n g t o o a n l t h e c y s t e v a c u t e l  
b u t t h e t u m o r d o u b l e d i n s i z e a n d e f f o r t s  
t o d a l s t h i t g a l l t o a l a r m i n g h a m o r r h a g e  
T h e l i f f o d d b y t h s s e c n d o p e r a t o n l a s t e d  
f o o n l y s i x m o t h s a n d t h u g h u n d e r o r d n a r y c i r  
u m s t a n s t h e a s e c o u l d h a v e b e e n r e g a r d e d a s  
u r g e n t l y h a p p e n i n g D r B o w e n f e l t t h a t v e m i g h t  
v a b l y l a b o r a t o r i z e a l e i o n o f t h i s t y p e  
a n l t h c h a n c e a s t a k e n T h e g r o w t h a s s h o w n b y  
t h p e r t u r k t h e s i n t h e a r t i c l e r e f e r e d t o h a l l  
l y t h i s t i m e (M i c h 1 9 1 9 ) c o m e c o m p l e t l y t o  
h i l l t h c e n t r l p o r t i o n o f t h e p o t e r o f o s a

I t w a s f o u n d b y s p r a y i n g t h e h i g h l y v a s c u l a r  
s u r f a c o f t h t u m o r w i t h t h e c o a g u l a t i n g c u r r e n t  
t h l a l l l t r o l b e i n g u s e d f o r t h p u r p o s e t h a t  
t h s u f a c c o u l d b e s h r u n k n a n d c h a r r l a s t h  
c e r e b e l l u m w a s g r a d u a l l y b r u s h e d a w a y f r o m i t  
n e r b y l o g a n i s t b e i n g p r o d u c e d B y t h i s  
m e t h o d v h t e p r s n t d p o s s i b l y t h u t e r h a l f f  
t h l e v a s g r a d l y b r o u g h t i n t o v i e w a n d  
o g u l t e d T h e c e n t r a l p o r t i o n o f t h e e x p o s e d  
s u r f a c w a s n a t u r a l l y s c a l l o p e d b u t s u c h a d e g r e e  
o f t h i d g o o b a n g a n o c c u r f r o m t h e r a w c a v i t y  
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p a r t i t s l g f o r p u r p o s e s o f i m p l a n t a t i o n b e f o r e i t  
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l o n v a f a l l y t i e d o u t s u f f i c i e n t l y t o p e r m i t  
t h b r p i n l f l u i d t o s c a p e f r o m t h d i l t d i t e r  
a n d a s t h p a t i e n t h a d b y t h t i m e b e g u n t o c o m p l a i n  
o f t h e d c o m f o r t s o f h e r p o s i t i o n o n t h e t a b l e t h e  
f l p s e r p l a c e d a n d c l o s e d i n t h e u s u a l d t a i l  
a f t e r w h a t h a d b e e n o v e r a f v e h o u r s s o n

W e w e r a t t h i s t i m e u n a w a r e o f t h a t e f f e c t t h  
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m i g h t h a v e u p o n t h e m d u l l a N o r h d k n o w  
h o w e l l t h l r g e s c a r s c h c h v a s l f t b e h i n d  
c o u l d b e t o l e a t e l b y t h e n e v e l o p i n g t i s u e O u r  
a p p r e h e n s i o n s o n t h s e s c s h a p p i l y v e r e u

g r u n d l s h m l a n i m m e d i a t e e x c e l l e n t r e c o v e r y  
a n d s h o e l n o s i g n s o f r e a c t i o n A t t h e e d o f a  
w e e k s t i m e f a r i n g t o a i t l o n g r l s t i c s h o u l d b e  
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a g a i n e p o s d t h i t i m e u n d e r e t h e r a n e s t h e s i a  
a n d a f t e r t h r e m a i n d e r o f i t s s u r f a c h a d b e e n t r e a t  
e d i n t h s a m e f a s h i o n a s b e f o r e i t v a s p o s s i b l e t o t h  
o u t w a r d t h c h a r r e l m a s t h e r b y e p o s i n g t h  
f u l l g t h o f t h e l i n e d a n d n a k e l f l o o r o f t h e f o u r t h  
v e n t r i c l e T h e b a s e o f t h t u m o r a s t h e n c l i p e d  
o f f d e h y d r a t e d n l r e m o v e d f r o m i t s a t t a c h m e n t  
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p a t i e n t m a l a n c e l l n t r e c o v e r y f r o m h e a n e s t  
t h i c i n l j a s e d a g o o l n i g h t b u t a r l y t h n e t  
m a i n s h e b g n t h a v e s o m e r s p e r t o r y d i f f i c u l t  
t i s f r m v h i c h s h s u c c u m b e d o n t h e m o r n i n g o f  
M i c h 5

I n t h i s c a s e w e h a d m a d e a d e p e r a t e t h r o w  
a n d f a i l e d w h e t h e r f r o m p o o r j u d g m e n t o r  
i n e x p e r i e n c e n e e d n o t b e d i s c u s s e d H a d t h e  
s a m e m e t h o d b e e n e m p l o y e d w h e n t h e t u m o r  
w a s s m a l l e r t h e o p e r a t i o n m i g h t w e l l e n o u g h  
h a v e b e e n c a r r i e d t h r o u g h t o a s u c c e s s f u l i s u e  
T h i s w e h a v e h a d t h e g o o d f o r t u n e t o d e m o n  
s t r a t e i n a m o r e r e c e n t c a s e A w a s e x p l a i n e d  
i n o u r m o n o g r a p h o n t h e s u b j e c t o f t h e e  
b l o o d v e s s e l t u m o r s t h e t r u e h e m a n g i o b l a s  
t o m a s a r e i n v a r i a b l y f o u n d i n t h e c e r e  
b e l l u m s o m e o f t h e m b e i n g c y s t i c a n d o m e  
o f t h e m l a r g e l y s o l i d l e i o n s A n d a m o n t h  
a f t e r t h e f a t a l o p e r a t i o n d e s c r i b e d w e h a d  
m a d e s u f f i c i e n t p r o g r e s s t o e n c o u r a g e u s t o s e n d  
f o r a n o l d p a t i e n t k n o w n t o h a r b o r o n e o f  
t h e s e f o r m i d a b l e l e i o n s o f t h e l a t t e r t y p e



Figs 23-4 Case 6 The patient on her discharge showing slight residual right facial palsy which soon disappeared

out further experience it is impossible to tell whether vascular malformations of this nature can be effectively attacked. We have found experimentally however that vessels of considerable size may be sealed by compression with the ball electrode and the employment of a slowly coagulating current. All of this needs very careful further study.

*Cerebral Gliomas* Our early electro surgical experiences as already stated were largely restricted to the development of the methods of treating the meningiomas in the manner described and our first essays to deal with the tumors composed of elements of the nervous system were unsatisfactory. However what we might some day learn to do was foreshadowed by an occasional experience like the following in which the exposed surface of the lesion lay uncovered in the wall of a large cyst

CASE 9. The patient (Surgical No 28547) a young man seventeen years of age had been previously operated upon in June 1904. At that time he presented unmistakable symptoms of a left temporal lobe lesion and at the operation a massive subcortical glioma of a comparatively benign type (astrocytoma) was for the day radically attacked and in large part removed though because of bleed-

ing a visible portion of the tumor in the depth of the lobe was left behind. The flap was replaced leaving a subtemporal defect.

The patient made an excellent recovery and had been steadily at work as a farm hand until a month before his re-admission at which time the subtemporal decompression began slightly to protrude and some of his former symptoms to return. He reported this fact and was requested to re-enter the hospital for examination.

He proved to be in such excellent physical condition that under ordinary circumstances one would have felt inclined to advise delay for in spite of an occasional headache he was well able to continue earning his livelihood.

At the operation on April 14 1907 on once more reflecting the old bone flap under local anesthesia a huge temporal lobe cyst containing at least three hundred cubic centimeters of xanthochromic fluid was encountered and evacuated. With the cutting current a long incision was then made quite bloodlessly through the overlying fibrotic tissues at the site of the old decompression. In the floor of the widely opened cyst was seen a solid mass of recurrent tumor the size of a hen's egg. This large mural tumor was removed in two large fragments (Fig 27) with extraordinary ease by the aid of the dehydrating current. The growth appeared to lie in the fork of the dislocated ventricle which was widely opened in the process of its removal. The tissues actually melted away miraculously before the sparking point in a manner that would not have

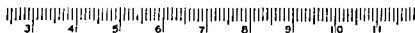


Fig. C. 6. The uterus, fallopian tube, and ovary, showing the gross pathology. (weight 6 gm.)

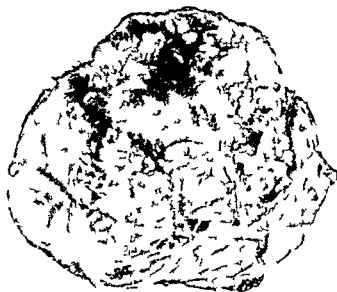


Fig. C. 6. The surface of the ovary, showing the gross pathology. (weight 6 gm.)

*Cerebellar Gliomas* Gliomas which arise from or involve the roof of the fourth ventricle are very common lesions particularly in childhood as the writer has elsewhere taken pains to point out<sup>1</sup>

Even before we began to employ electro surgical methods of operating we had begun radically to attack these tumors and many of them had been successfully removed the ultimate prognosis varying in accordance with the pathological nature of the lesion whether a highly malignant medulloblastoma a less malignant ependymoma or a relatively benign astrocytoma. It is perhaps incorrect to speak of them as fourth ventricle tumors rather than as tumors of the vermis though in their removal as was described above in connection with Case 7 the widened ventricle is usually laid bare from the distended iter to the calamus

The operations are time consuming technically difficult and demand full bilateral exposure of the cerebellum oftentimes with removal of the laminae of the atlas. It is impossible to carry out the necessary manipulations through the single vertical or transverse incisions that have recently come to be advocated for cerebellar operations. The crux of the enucleation lies in the control of bleeding from the choroidal branches of the posterior cerebellar arteries in the tonsillar region adjacent to the calamus for it is from this source that these median tumors appear to receive their main blood supply. Should one of these vessels fail to be clipped or coagulated before its division it is often most difficult to secure the bleeding point and interstitial bleeding in this region is attended with great danger.

The posterior end of many of these tumors lies exposed between the tonsils so soon as the cisternal arachnoid is opened. Others are only exposed by drawing the tonsils up out of the foramen and separating them so as to bring the calamus and triangle of Magendie into view. Still others are not visible on the surface but their presence is betrayed by an unnatural prominence or widening of the uvula. Under these circumstances the elec-



Fig. 6. Case 7. The remains of a large capillary hemangioblastoma of the fourth ventricle charred and shrunken by electrode coagulation before its removal at a second session with fatal result from pneumonia.

tro surgical methods can be effectively utilized in place of the scalpel or blunt dissector in making the long median incision through the vermis down to the tumor which even when large often lies at a surprising depth.

When the surface of the growth has been well exposed by brushing each of the divided cerebellar hemispheres to the side it may be primarily excavated in various ways depending largely upon its consistency. When it is too soft to be handled as is true of most of the medulloblastomas the sucker must be largely resorted to but even under these unfavorable circumstances electrical methods are constantly called for to control bleeding points more particularly as one approaches the vascular stalk of the tumor in the region of the calamus.

These operations for fourth ventricle tumors are relatively common ones there having been thirty five examples verified during the past two years few however of such seriousness as that for the fourth ventricle hemangioma (Case 7) described above. One or two of the cases in which the electro

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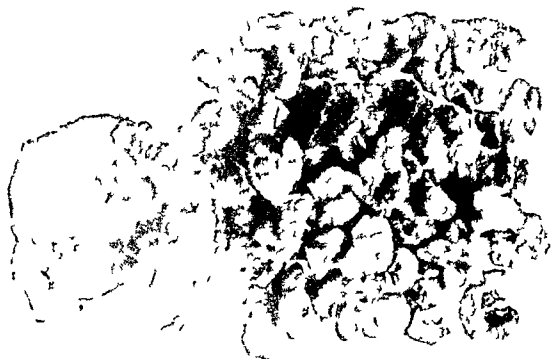


Fig. 8. a) a photograph of the subtemporal region showing the removal of the accumulation of cerebral fluid due to the operation.

The boy made a prompt and excellent recovery (Fig. 8 a) after the subtemporal region was removed. The removal of the accumulation of cerebral fluid due to the operation.

This happens to have been the first case in which a wooden table and wooden spatula were employed and the avoidance of any discomforts or physiological reactions was ascribed to these accessories. Their importance was unduly emphasized as we now know but under the encouragement of this experience we began gradually to gain confidence in attacking cerebral gliomas of varied sorts and in time learned with properly modified currents how to make transcortical incisions with comparative bloodlessness and without getting the electrode gummed with tissue in the process. As a result of this we have become even more radical than heretofore in

the removal of the cerebral tumors for the former methods of block dissection were apt not only to be somewhat messy and bloody but there was always the likelihood of inoculating the raw tissue with viable tumor cells—a risk greatly lessened when electrical methods of dissection are used. The detail of procedures of this type need hardly be gone into for they differ greatly from case to case and they are unquestionably capable of vast improvement in technique which will doubtless come to be perfected given time and experience.

It may suffice to say that the removal of glioma containing lobes of the brain (frontal, temporal or occipital) may be enormously facilitated by electro-surgical manipulation and should one apprehend that the nervous tissues lining the raw cavity still contain tumor or have been infected by implantation of tumor cells as a last step in the lobectomy the raw surface may be gone over by the loop and as many additional thin layers of tissue be scalloped out as may seem necessary.

Fig. 8. b) a photograph of the subtemporal region showing the removal of the accumulation of cerebral fluid due to the operation.

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Fig. 26. Case 7. The remains of a large capillary hemangioblastoma of the fourth ventricle charred and broken up by electrocautery before its removal at a second session with fatal result from pneumonia.

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f. th. m. b. g. be. fou. th. t. u. t. m. th. g. t. m. jo. t. occu.  
g. h. id.



5 6 7 8 9 10 11

Fig. 5. Cerebellum. Tumor. Fig. 6. Tumor. Fig. 7. Tumor. Fig. 8. Tumor. Fig. 9. Tumor. Fig. 10. Tumor. Fig. 11. Tumor.

urgical adjunct was first employed may serve in illustration

CASE. The patient (Surgical No. 8604) a hill eight years of age, was admitted on Sept. 11, 1917, with a choked disc of 5 diopters, second hydrocephalus and a full blown cerebellar syndrome. On Oct. 11, 1917, an operation was performed without the customary delay for detailed study. During the course of the surgical exploration under local anesthesia with a ventricular puncture to diminish the tension, a highly vascular median tumor was exposed. It was thought to be a hemangioma and was considered to be operable. A small fragment was removed for verification. It proved subsequently to be a greatly infiltrated to determine the histological type of lesion. She was nevertheless given a series of X-ray treatments and did extremely well for the next six months during which she remained free from symptoms.

Her mother reported that in April, 1917, that she had begun again to have occasional attacks of morning vomiting and in the hope that the tumor might possibly be removed by electrical methods and believed that it would be better not to delay until the beneficial effect of the decompression had been wholly lost. The child was readmitted for a secondary operation.

The clinical history contains the following note which was dictated immediately after the operation on April 1, 1917, when the sketches (Fig. 30) were made and the steps of the procedure fully described. It tells more vividly than would now be possible or per-

missible the impressions of the case at the time.

Of the extraordinary and revolutionizing experiences we have had in the past month this case thinks exceeds them all.

The child's recent entry to the hospital after a former decompression, the subsequent radiation has been absolutely free from any evidence of tumor. I had almost begun to feel that I had better postpone further intervention as unnecessary on the assumption that the tumor must have been absorbed by the X-ray. I had not the slightest suspicion that we were to find a far larger tumor than originally exposed.

I am not at all sure whether the tumor that was found is a hemangioma after all. It may possibly be a medulloblastoma or indeed an astrocytoma. There was no evidence of the great vascularity which caused us to cut short the primary operation and

which may possibly have been due solely to stasis.

Even so, without the electrical devices I probably would not have done more than to give this growth a partial removal by suction and probably would never have gotten it very fully in view. Particularly in the neighborhood of its lower pole, where the attachments were dense and vascular and bled at a touch, but they simply melted away before the dehydrating current.

So far as I could see for the first time one of these fourth ventricle tumors was removed intact without leaving behind even a suspicious tag of tissue. In the process a new maneuver was employed in that the growth after being freed as effectively as possible on the near deep well under the tentorium was then pressed to the opposite side by the wooden spatula. The lateral wall of the dilated ventricle thus put on the stretch then electrically opened by a bloodless incision the full 6 centimeter length of the enticle. This made it possible for the tumor to be tilted out until the opposite wall as shown in the sketch (Fig. 30) was in its turn similarly divided thereby permitting the growth to be lifted out in its entirety (Fig. 31).

There is one important point which should be mentioned in that the dehydrating current proved distinctly a better method of separating the growth from the adjacent cerebellum than the ordinary method of brushing it away for owing I presume to their relatively greater content of water the nervous tissues melted away before the sparking current leaving the surface of the growth clean and exposed. In the customary procedure of dissecting the brain from a lesion of this sort one is likely sometimes to get more deeply into brain than is desirable or on the contrary and what is still

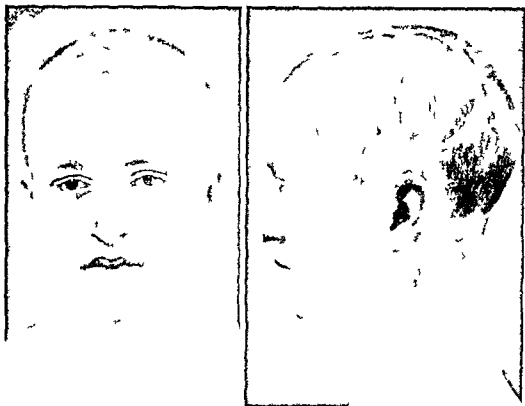
worse occasionally to break through the surface of the tumor

This brief preliminary statement as it occurs in the record tells about as much as does the detailed account of the operation that follows it apart from the fact that it dismisses with slight reference the difficulties of re-exposing the growth because of the dense adhesions due to the old operation in the separation of which the cutting current proved infinitely superior to the scalpel. Nor does it mention the fact that the vascular surface of the growth was sprayed and shrunken with the

damped dehydrating current as it was gradually brought to view. The tumor proved to be an astrocytoma composed mainly of protoplasmic elements which gives the case (Figs 32-34) a most favorable prognosis.

When these fourth ventricle astrocytomas are accompanied by a cyst the problem is greatly simplified particularly if the cyst lies superficial to the mural nodule so that it lies fully exposed. Examples of the manner in which these lesions may be dealt with under these favorable circumstances are shown in the accompanying sketches. One (Fig. 35) shows a comparatively small medially placed nodule attached to the roof of the ventricle; the other (Fig. 36) shows a larger mural tumor which was laterally placed in the right hemisphere.

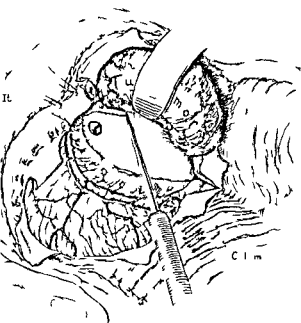
In past years surgeons were apt to congratulate themselves on the mere evacuation of a glomatous cyst which of course leads to an immediate brilliant operative result. But painful experience has shown that the cyst is not an evidence of degeneration of a lesion and that somewhere in its wall lies a tumor



Figs. 28-29. Case 9. The patient 14 days after operation for a recurrent temporal lobe tumor showing fullness of subtemporal region due to temporary tendency of cerebrospinal fluid to accumulate because of the widely opened ventricle.

nodule from the surface of which the xanthochromic fluid exudes and in time the tumor unless it is removed may come wholly to replace the former cyst. Under these circumstances its total removal at subsequent operations becomes increasingly difficult with each attempt because of the tissue adhesions which form. I have under continued observation a patient who as a lad of nine years was first operated upon in 1907 when I jubilantly enucleated a cerebellar cyst. Since then he has grown to young manhood but in the intervening twenty years owing to recurring symptoms due to the progress of his slowly infiltrative astrocytoma he has been subjected to six operations until there is little of his cerebellum remaining. Had the nature of the process been appreciated in 1907 it might even at that early day have been removed at a primary session and both patient and surgeon been spared much tribulation.

When these fourth ventricle astrocytomas are found at their first exposure to be unaccompanied by cysts the problem is quite



3 C. I. m. I. p. a. e. k. e. t. h. h. w. g.  
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Fig 3 C. Th. h. r. u. l. e. n. d. l. e. of  
f. f. t. h. e. n. t. l. t. u. m. f. t. f. a. t.

er one. It is rare that they can be  
ed in their entirety as in the operation  
se so that has been recorded in detail  
usually necessary partly to excavate the  
before it can be bruised away from  
rebellar hemispheres without producing  
contusion and so far as possible  
g the manipulation of the tumor pres  
upon it must be avoided because of its  
on over the medulla the respiratory  
anism in many cases already compro  
being easily upset.

example of one of the solid tumors  
happened to be an unusually firm  
loblastoma but which on May 17  
had been thus treated by primary  
ical excavation before removal is shown  
the accompanying photograph (Fig 37)  
the operative sketches (Fig 38) give some  
stages of its removal. In the case  
in Figure 39 the tissue was electrically  
and it two halves removed in succe  
sion. On other occasions it may be  
difficult or impossible to remove the  
tumor portion of the lesion owing to its

dense attachment to the region of the cala  
mus. An example of this is shown in Fig 40  
the removal of the residual nodule was  
given up as too hazardous.

The general run of soft medulloblastomas  
that occupy this same region are less suitable  
for electrical scalloping and are most effect  
ively attacked by suction. The technical  
problems necessarily differ considerably from  
case to case and each tumor has to be ur  
gically manipulated according to its peculiar  
ities. Fourth ventricle tumors are alike  
merely in the fact that the chief point of  
particular danger lies as may be reempha  
sized in the method of controlling the chief  
vascular attachments which lie along the  
calamus for which purpose electrical coag  
ulation is more likely to be effective than the  
employment of clips.

*The Acoustic Tumors* Because of their  
characteristic symptomatology the acoustic  
neurinomas are possibly the most easily  
recognized of any intracranial tumors. More  
over they are inherently benign lesions. And  
yet from a technical standpoint particularly



Fig. 3, 4. Case 10. Patient May 1934, at time of discharge. The bald patch is due to the former radiation which so far as known is ineffective for astrocytoma.

when they have attained a large size they offer greater difficulties than almost any other tumor with which the neurosurgeon is obliged to deal. Though the usual run of these patients came to operation during the first few months when we were grounding ourselves in the first principles of electro surgery difficulties were experienced owing to the spread of the current to the nerves enveloping the tumor physiological responses being produced which were most disturbing to the patient. Consequently about all that the electrical adjunct could be used for was as a purely supplementary measure for coagulating dural margins and possibly for making the primary incision into the tumor and sealing some of its surface vessels.

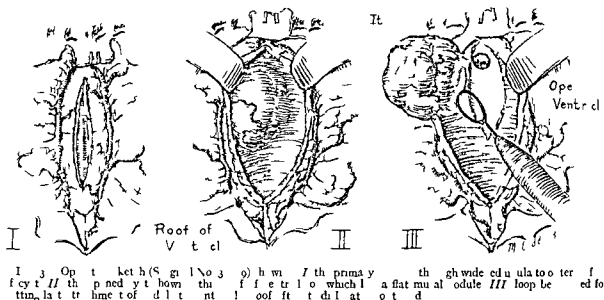
However during the past six months we have come to modify our traditional method of exposing these awkwardly accessible growths and as a matter of fact we were forced into the manoeuvre owing to the urgent postoperative complication in the case to be described.

**CASE 11.** The patient (Surgical No 30497) a foreigner was admitted with an advanced cerebellopontile syndrome. On account of marked mental changes he was wholly uncooperative. He was bedridden because of his ataxia nearly blind from secondary atrophy and there was extreme dis-

phagia. The operation had to be begun under ether narcosis which he took badly. His respiratory embarrassment was such that in spite of a ventricular puncture there was sufficient stasis to cause undue loss of blood.

The tumor a large one was finally well enough exposed to permit of a partial intracapsular enucleation a slow process as the growth was firm and vascular. Owing to the patient's condition it was necessary to withdraw without having accomplished much more than a decompression. The wound was closed none too easily and as is customary the patient was left face down on the table to await the full recovery from the anesthetic. This he failed satisfactorily to do. Gradually respiration became still more embarrassed with increasing cyanosis a falling blood pressure and rising pulse rate. It was evident if life were to be saved that the desperate chance would have to be taken of re opening the wound—always a most disheartening procedure.

Preparations for resuming the operation were made and the carefully closed wound was reopened. The evident cause of the compression was a swollen oedematous and infiltrated cerebellar hemisphere overlying the growth for on its release the patient's respiration and color almost immediately improved. There was nothing for it but to remove a large crescent of the hemisphere. This was accomplished with amazing ease and quite bloodlessly with the dehydrating current. The tumor which previously had been awkwardly exposed under the margin of the retracted hemisphere then lay fully bared to view. It was radically excavated with the loop electrode until its capsule could be fully collapsed



that the anterior portion of the growth which was edged alongside the pons in the tentorial opening could be released.

Though the loss of blood had been considerable and though the two operations had consumed over five hours the patient began immediately to improve and a month later he was able to walk out of the hospital in unusually good condition for the victim of an acoustic tumor that had attained such a large size.

What was particularly unexpected in this man's case was the fact that the postoperative cerebellar symptoms were if anything less marked than one usually sees in comparable cases when the cerebellar hemisphere has merely been retracted and left in place. We had fully anticipated that the removal of what must have amounted to practically the lower third of the hemisphere would leave the corresponding leg and arm so ataxic that they would be practically useless.

Since this illuminating experience we have adopted this method as a preliminary step in exposing other acoustic tumors (Fig 41) and have not only been able thereby to get a far better primary view of the lesion but have come to feel that in advanced cases a partial cerebellar extirpation is in the long run less likely to accentuate pre-existing ataxia than did the inevitable contusion of the lobe that was formerly produced by the method of retraction.

How far one may go with the adoption of this principle of removing the uninvolved shelf of brain that overlies a tumor rather than merely retracting it or incising through it down to the surface of the tumor with subsequent separation of the incised edges remains to be seen. The temptation will be great to extend the principle in regions where the cortex registers no important function now that the excision of tissue is so greatly facilitated by electrodesiccation. And the same thing applies as well to lobectomies for the mass extirpation of gliomas—a principle which should of course not be carried too far. The mere prolongation of life unless it can be made better worth living is not an accomplishment for the surgeon to pride himself upon as has often been emphasized.

As Dr. Bovie's preliminary note was written in May 1917 it has seemed appropriate to restrict the case reports in this paper so far as possible to an account of our early experience which had begun to accumulate during the spring of that year. In all of the operations the active electrode was used while attached to the hand-made pistol grip which he had devised and carved out of bakelite (Fig 42) the current being shot by the surgeon. Meanwhile a second person Dr. Bovie himself in those instructive days

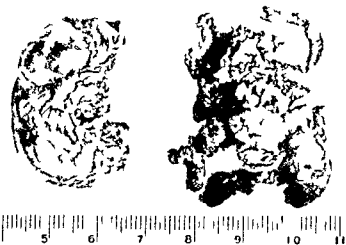


Fig 37 An unusually firm medulloblastoma of fourth ventricle (Surgical No 8154) removed after primary excision by calloping to reduce the size of the lesion

controlled the switchboard and modified the character of the current in ways he thought appropriate to the surgeon's particular needs of the moment

We had originally discussed the possibility of having keys on the handle of the pistol grip which would enable the surgeon himself to change and modify the currents employed so that an operator at the switchboard of the apparatus would no longer be required. But as a matter of fact we have tended in quite the other direction. For we have come more and more to dispense with the pistol altogether and to use the electrode as a pencil and this for reasons to be explained has made it necessary to take on an additional assistant instead of eliminating one as we originally planned to do

For gross work the pistol does well enough and it is of course a great convenience for the surgeon to have the current under the immediate control of his trigger finger. But for delicate dissection in dangerous places around the optic nerves and chiasm for example the movement of the electrode with the pistol in hand compared to the movement of an instrument held in the fingers like a pencil is exceedingly awkward. One need only attempt to write his signature with a pencil inserted in the muzzle of a revolver to appreciate the difference. We consequently have been obliged to take recourse to a foot switch which has been supplied with the

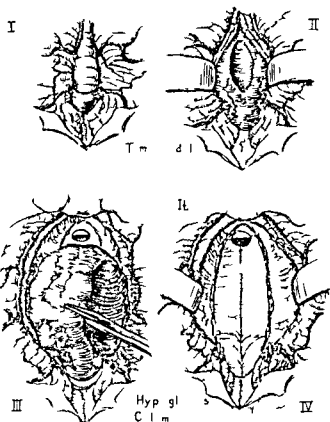


Fig 38 Operative sketches (reduced 1/4) to show steps in the electro surgical removal of a solid fourth ventricle tumor (Surgical No 8754) I shows appearance at primary exposure II after splitting the vermi and removal of primary scallop III the partly scalloped tumor being dislodged IV the bed of tumor with widely opened ventricle after removal of its roof together with tumor

newer models of the apparatus or better still to have an extra assistant cleaned up who not only holds the pencil when not in use but who often plays a far less passive role than this as may be explained

On one occasion (on April 26 1917 to be exact) a large right frontal glioma of a somewhat unusual type was exposed and attacked by electrical methods. In this process which necessitated the removal of the larger part of the lobe and the lying bare of the anterior falx an unusual number of vessels were encountered and since the operator's left hand was engaged in careful retraction of the brain while the right was holding the pistol the coagulation of these vessels though they were plainly brought to view was difficult to compass. The need was felt for some sort of a split pointed electrode that could be used for making incisions when closed and yet could be opened in the fashion of the usual duck billed forceps so as to pick





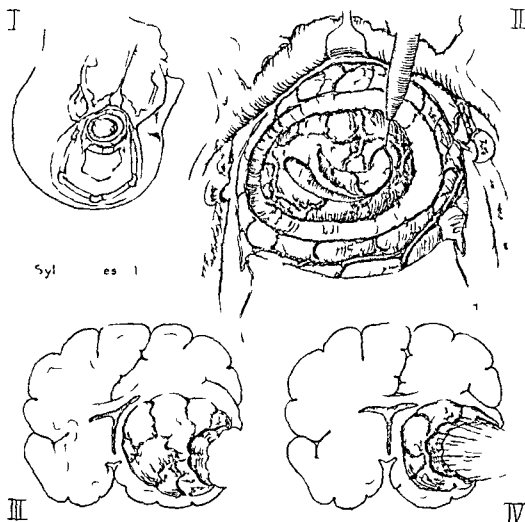


Fig. 43 To illustrate the successive stages of the electro-surgical removal of a large vascular meningioma occupying the temporal fossa and arising from the tentorium. After the primary uncapping of the lesion by electrical removal of the orbital disc of overlying cortex and after bridging the vascular surface of the exposed tumor with a ball electrode and coagulating spray, the sketch II shows the primary scallop in process of removal. III shows the condition at the end of the first session. IV at the end of the second session. The shell of the tumor was finally removed at a third session (Surgical No. 32127).

current (Fig. 43 II) it was necessary owing to excessive bleeding to keep the raw groove from which each piece of tissue had been looped out clean by suction and to shift from the loop to a ball electrode and from the cutting to the coagulating current before the surface could be sufficiently dried safely to permit the removal of the next fragment. Finally it was found that if the scallop of tissue was allowed to remain in its bed for a time or was held in place by the slight pressure of a cotton pledget it could be removed shortly with practically no bleeding.

There is no gainsaying that the employment of the Bovie unit or any other form of

current generator as an aid to the removal of a brain tumor adds a complication to an already highly complicated procedure. Yet in making a review of the early histories for purposes of this present communication I find it expressly stated over and over again that the particular procedure in question though an extremely prolonged and arduous performance was one which without the electro-surgical adjunct would have been impossible to carry through to a safe conclusion.

During the two years that have elapsed since we hesitatingly began to employ the currents in craniocerebral surgery five hundred and forty seven operations for tumor have been

performed. Though for some of these operations the electrical methods were not essential there were few of them even when no tumor was found in which they could not advantageously be employed. The currents are useful even for such trifle as brushing the surface of the dura with the ball electrode in order to seal the torn meningeal veins from which persistent oozing may sometimes try one's patience or similarly for checking the persistent oozing points on the under surface of the reflected bone before its replacement or for coagulating some refractory vessel on the incised dural margin. To be sure muscle implantation, bone wax and silver clips have long been used for these several purposes and they cannot be wholly dispensed with even now, but on the whole electrical methods usually serve to accomplish the same ends more expeditiously.

Nearly twenty years have passed since Pozzi announced to the Academy of Medicine in Paris a method for the cure of malignancy by

the action of sparks from the terminal of an Oudin resonator a procedure termed fulguration as Dr. Bovie mentions in his introductory note. Slowly and gradually the original procedure has been modified and extended until for the treatment chiefly of cutaneous lesions and of official malignancy it has gained enthusiastic advocates. The possibilities of electro desiccation and coagulation nevertheless have not as yet come to be sufficiently appreciated by the general surgeon who has been prone to regard what are called surgical endothermy or diathermy as merely refined methods of tissue cauterization.

Surgery is a conservative art. It takes to novel methods reluctantly as an old dog to new tricks. It was slow to adopt the ligature, slow to adopt the principles of antiseptics, slow to adopt the fastidious technique and painstaking hæmostasis that have largely put a stop to operating by the clock. It has been equally slow to adopt the principles of electro surgery which from a technical standpoint are likely to be no less revolutionizing

## A STUDY OF UTERINE AND TUBAL DECIDUAL REACTION IN TUBAL PREGNANCY

BASED ON THE HISTOLOGICAL EXAMINATION OF THE TUBES AND ENDOMETRIUM  
OF FIFTY-THREE CASES OF ECTOPIC GESTATION<sup>1</sup>

By ALAN R. MORITZ, M.D. and MARION DOUGLASS, M.D. CLEVELAND, OHIO

I m th D p tm t f P th l gy d C y ee l y f th W t P U ty S hog l f

MANY modern writers have indicated either by implication or direct statement that they believe that the development of an extra uterine pregnancy constantly produces a decidural reaction in the uterus which is similar to that associated with a normal pregnancy (Anspach Aschoff Graves Herxheimer Kaufmann Williams and others).

Boehmerus in 175 was the first to observe the formation of decidua in the uterus in a case of extra uterine pregnancy and his finding was corroborated a few years later by William Hunter. That this point soon became controversial is shown by Parry's review of the subject of extra uterine pregnancy in 1876. He stated that some investigators believed that decidua is always formed in the uterus others that it is found in the gravid tube while still others have reported the finding of both uterine and tubal decidua in cases of tubal gestation. Parry concluded that uterine decidua is formed constantly in cases of extra uterine pregnancy and stated the opinion of this astute observer (William Hunter) thus plainly expressed more than a century since may still be accepted as the truth and had others been equally careful in their investigations a great deal of useless discussion would have been avoided. This apparently ended the controversy that so distressed Parry.

Strahin in a review of the subject in 1889 wrote that it was then universally admitted that the endometrium undergoes development into true decidua in cases of tubal pregnancy. In his monograph on ectopic pregnancy (1911) Schumann disposed of this question by the following statement: "The influence of an impregnated or imbedded ovum wherever situated always brings about an evolution of

the uterus to some degree with the development of a decidua vera in that organ.

Duguet observed that uterine decidua is not always found but pointed out that it is usual for the uterine decidua to be desquamated during the profuse menses which so commonly occur previous to tubal rupture. Novak and Telinde as well as Schumann explained the absence of uterine decidua at the time of operation by the occurrence of fetal death sufficiently long before operation to permit desquamation of decidua and endometrial regeneration to occur.

Since the whole matter is still in an unsettled state the study of the uterine curettings and fallopian tubes in a series of cases of tubal pregnancy from the Gynecological Service at The Lakeside Hospital was undertaken in order to determine the frequency of the occurrence of uterine and tubal decidua in these cases as well as the frequency of vaginal bleeding and its relation to the state of the chorionic villi endometrium and embryo.

Table I contains the data concerning the 53 cases of tubal pregnancy here reported. Histological material for a study of the endometrium was accessible in all cases but the gravid tubes were not in every instance accessible for complete histological examination since in certain cases only the contents were sectioned. However all of the cases here reported are of unquestionable tubal pregnancy.

Only 8 of the 53 cases showed decidua for mation in the endometrium (Fig. 1). The endometrium in 29 instances was in the resting phase while in 16 it showed varying degrees of cyclic hyperplasia.

A study of the 45 cases having a non decidual endometrium indicates that in a cer



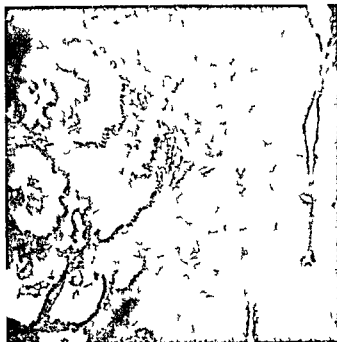


Fig. 1 No 1469 Typical uterine decidua in situ showing Opitz gland of pregnancy and decidua of ectopic pregnancy

construed as involuting decidua or as retained degenerated decidua. We must conclude that uterine decidua had not formed in these 6 cases.

Tubal decidua was found in 26 cases (Table I). We do not mean to imply that tubal decidua was present only in 26 cases because in several instances either a study only of the tubal contents was made or the diagnosis of pregnancy was made on the gross finding of a fetus. In a number of instances an adequate examination of the tube was not made and the study was limited to a few sections. It is to be noted however that of the 26 cases in which tubal decidua was found endometrial decidua was present in only 5. It is therefore apparent that the development of tubal decidua is far more frequent than the development of uterine decidua in these cases of tubal pregnancy. Whatever stimulus regulates the formation and development of tubal decidua may reasonably be assumed to be responsible likewise for the formation of uterine decidua. It appears probable that in these 11 cases uterine decidua had not developed (Figs. 3, 4, and 5) if it had developed it should still have been present. It does not seem logical that the uterine decidua would desquamate and the tubal decidua persist.

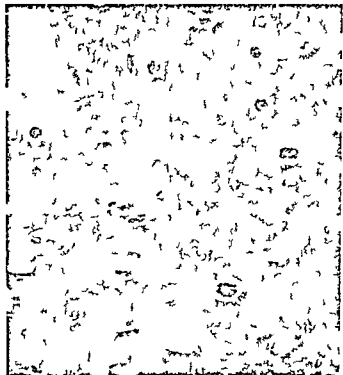


Fig. 2 No 17433 Resting endometrium found in a case with a history of vaginal bleeding prior to operation. Inasmuch as there was no history of bleeding or passage of decidua, it seems likely that decidua in the uterus had not been formed.

There were 4 cases in the series in which the fetus found at operation was in an excellent state of preservation or was living. Their importance is sufficient to justify a brief case presentation.

CASE 1 No 5190 Mrs. J colored 30 years of age entered the hospital with a complaint of vaginal bleeding and lower abdominal cramps of 8 weeks duration. Her last menstrual period had been 12 weeks prior to admission. At operation a well developed approximately 2 month fetus was found attached to the ruptured right tube. The fetus showed no signs of postmortem change and if not alive at the time of operation had been dead only a very short period. The uterine curettings showed a well preserved intact decidua.

CASE 2 No 14159 Mrs. B colored 35 years of age entered the hospital with a complaint of vaginal bleeding of 4 weeks duration. She had had 11 periods previous to the onset of this duration. At operation a 12 centimeter fetus was found attached to a recently ruptured right tube. There was wrinkling or desiccation to indicate that the fetus had been dead any considerable time. The uterine curettings showed a resting endometrium.

CASE 3 No 14400 Mrs. H colored 31 years of age entered the hospital complaining of lower abdominal pains in the lower abdomen which had been present for a month. Her last menstrual period was 6 weeks before her admission. The fetus was found in the lower abdomen.



FIG. 4. R. G. L. M. P. T. T. H. J. S. F. F. M. T. W. L. D. T. Th. K. T. T. Th. T. F. I. D. F. I. T. Bl. I. T. T. I. A. Th. L. M. T. M.

lat. l. fo. 4. k. H. p. you. f. r. l. h. l. b. c. n. r. g. u. l. r. At operation a well preserved decidual tube. f. tu. s. fou. l. att. h. d. t. ruptu. d. l. f. tube. l. h. ut. u. t. t. g. h. o. l. a. r. c. t. i. n. g. e. n. d. o. m. t. r. i. u. m.

CASE 4. No. 18180. Mr. G. H. T. 30 years of age. r. d. th. hosp. t. l. m. p. l. a. g. of pain in the l. a. b. l. o. m. h. h. h. d. been p. e. s. n. t. f. r. k. prior to adm. Vaginal bl. d. g. h. d. b. e. n. u. l. m. s. t. o. n. t. u. o. u. s. d. r. i. n. g. t. h. p. t. 8. c. k. At p. t. o. n. a. n. r. p. t. d. l. f. t. u. t. e. v. f. u. l. i. h. h. t. h. r. t. a. t. a. m. n. t. i. s. c. l. o. n. t. g. a. l. l. p. d. a. p. p. a. r. n. t. l. l. 14 m. m. ter. e. m. b. r. y. o. A. l. l. d. l. p. e. d. n. d. o. m. t. r. i. a. l. l. i. d. u. r. w. a. o. b. d. t. h. u. t. e. r. i. n. e. r. e. t. t. g.

Only one of the four cases showed a decidual reaction in the uterus. The endometrium of three cases and was in a regressing phase although in the first a 1 centimeter and in the second a 1 centimeter well preserved apparently living fetus was found. These patients were between 3 and 4 months pregnant at the time of operation but there was no evidence of uterine decidual formation.

It is often impossible to say with certainty whether an embryo or fetus is alive when seen at operation. It is possible however to tell the difference between a fetus which has been dead for 4 weeks or more and one that is grossly normal. In each of these four cases the fetus certainly had not been dead as long as the duration of the vaginal bleeding. It is



FIG. 4. N. S. D. l. l. t. o. th. th. t. u. l. l. g. l. l. d. p. t. f. t. h. t. b. l. l. m. l. g. 3. l. l. m. t. m. t. g. t. g. of th.

seen that vaginal bleeding varying from 4 to 12 weeks in duration had occurred prior to operation. Vaginal bleeding therefore does not invariably indicate fetal death.

Table I shows that in 46 of the 53 cases there was a history of vaginal bleeding varying from 1 to 12 weeks in duration prior to operation. An attempt was made to establish some connection between the bleeding and either the condition of the endometrium or that of the gravid tube. Schumann states that so long as the life and growth of the ovum progresses without interference there is no uterine bleeding and the development of this sign invariably predicates death of the embryo or at least beginning separation from the false decidua into which it has imbedded. Iolak and Welton concur with Schumann and in their experience uterine bleeding marks the death of the embryo. They believe further that as long as a chorionic villus remains alive the bleeding may continue.

Because vaginal bleeding is such a common symptom of ectopic pregnancy and because the physiological state of the endometrium is seen in the curettages of 25 of these cases was

TUBERCULOSIS OF THE GENITAL TRACT<sup>1</sup>BA HERMAN C BUMPUS JR M D F A C S ROCHESTER MINNESOTA  
Sec U l g y Th M y Cl cAND  
GERSHON J THOMPSON M D ROCHESTER MINNESOTA  
F l w U l g y Th M y F u d n

**I**F the mode of entry of an infection is unknown and the method of treatment is uncertain interest in the subject is always aroused. Tuberculosis of the genital tract is no exception to this rule. A review of the literature will show

Is the disease primary in the epididymis vesicles or prostate? How often is the urinary tract also involved? Should epididymectomy be performed? Is removal of the entire seminal tract preferable to epididymectomy? If epididymectomy is performed what are the chances of involvement of the remaining epididymis? Can epididymectomy be considered as a curative procedure or only a palliative one? What are the chances of the post operative formation of sinuses? If they occur how long do they persist? What is the life expectancy in these cases? If treatment is not instituted what will be the outcome? What are the determining clinical signs of tuberculous and non tuberculous epididymitis? These are some of the many questions uppermost in the physician's mind when he encounters a case of tuberculous epididymitis. We shall cite from modern literature on these controversial points and add a review of 300 cases which were observed at the Mayo Clinic prior to January 193. The cases occurring within the last 5 years have been excluded in order that the final results might be better determined. One hundred seventy five of the patients were operated on. Two hundred fifty eight were traced. We believe this series is large enough to permit the drawing of deductions of clinical value.

## DIFFERENTIAL DIAGNOSIS

In a review of this series of cases we noted the listing in the histories of the following intrascrotal lesions

*A Traumatic origin* (1) hematoma and ( ) torsion of the cord with hydrocele

*B Infectious origin* (1) gonorrheal epididymitis and hydrocele ( ) non specific epididymitis and hydrocele and (3) syphilis of the testis and epididymis

*C Tumors of the epididymis* (1) angioma ( ) lipoma (3) carcinoma (4) fibroma and (5) dermoid

*D Tumors of the spermatic cord* (1) lipoma ( ) fibroma (3) sarcoma (4) hematocele and (5) spermatocele

*E Tumors of the testicular tunics* (1) sarcoma and (2) fibroma

From the foregoing it may be seen that the differential diagnosis in these cases is not always simple.

In the diagnosis of tuberculosis of the genital tract evidence of a tuberculous lesion elsewhere should naturally be looked for in the urinary tract first. If it is found the probabilities are that the thickened epididymis is tuberculous. Stevens who reviewed the cases at Bellevue Hospital stated that if urinary tuberculosis is diagnosed the suspected lesion in the epididymis will be found to be tuberculous in more than 90 per cent of the cases. In 79 of our cases (36 surgical 43 clinical) dysuria was present and in all but 7 renal tuberculosis was demonstrable. Barney (2) in a study of 154 cases of tuberculous epididymitis noted tuberculosis of other parts of the body in 55.8 per cent involvement of the lungs being most common 27 per cent.

In 112 of the 175 surgical cases all verified by microscopic examination of the removed tissue, there was no sign of tuberculosis other than that of the urogenital tract. In the 63 remaining cases there were 9 in which there was healed or questionable involvement of the lungs 7 in which pulmonary tuberculosis was active 19 in which there was tuberculosis of the bones or joints (9 associated with slight pulmonary lesions) and 8 in which there was lymphatic involvement (3



decidua is constantly found at the implantation site if the chorionic villi are intact

3 Vaginal bleeding is a common symptom of ectopic pregnancy and is not necessarily associated with the death of the fetus the condition of the chorionic villi or the physiological state of the endometrium

## BIBLIOGRAPHY

- A 34 B M (v l gy I l l d lph ) 7  
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the main arguments relative to treatment however depend on the settling of this point.

If the epididymis can be shown to be the initial site of the disease, the simple procedure of epididymectomy becomes logical. If on the other hand it is shown that the disease originates in the prostate or seminal vesicles the radical removal of the genital tract with out the testicle would be the accepted procedure.

Those who believe that the prostate is the initial site of the disease including Walker who has had a great deal of experience in experimental work point out that when apparently recent tuberculous lesions are found in the epididymis the process is usually far advanced in the prostate and vesicles. They further state that the lesion usually develops in the lower pole of the epididymis where it would be expected that infection by way of the vas deferens would first appear. They have noted similar involvement by gonococci which as shown by Rolnick enter through the lumen of the vas deferens. They ask why a different mode of entry should be advocated for the bacilli of tuberculosis. If lesions of the epididymis are examined microscopically it is found that those in the lower pole seem to be more advanced than those in the upper pole. Although the apparent duration of a tuberculous process does not necessarily determine its priority lesions of the epididymis have been produced experimentally by the injection of the organisms into the urethra in cases in which the testicle has been injured previously.

Young in a most comprehensive article on the subject in which he advocates the radical removal of the entire seminal tract asserts that the primary focus is not in the prostate or epididymis but in the seminal vesicles and quotes Guyon the father of modern urology who believed that the tuberculous process usually begins in the seminal vesicles and that the involvement is from urethra outward toward the external genitalia.

Without overlooking the pathological and experimental evidence brought forward by others Braasch (4) Caulk (6) and Barney (2) all emphasize the striking clinical indications that the infection is primary in the

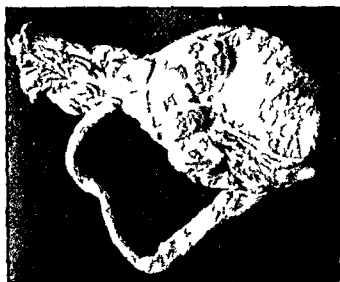


Fig. 1. Tuberculosis of the entire epididymis. Tuberculous nodule at the junction of the vas and the epididymis extending for 2 or 3 centimeters along the vas.

epididymis. Caulk says "I have seen any number of prostatic and vesical tuberculous lesions healed after removal of the external genital tuberculosis." Braasch says "Examination of these patients several years after operation shows that the prostate which was formerly firm and nodular is now much smoother and softer and frequently scarcely palpable. The same is true of the seminal vesicles."

In 5 cases in our series in which a subsequent examination was made some time after epididymectomy the prostate and seminal vesicles appeared to be normal while in 35 others they were nodular but apparently not causing trouble. We know of only one patient who was not examined who subsequently required operation on the prostate and vesicles.

Barney asks "If genital tuberculosis arises in the prostate or even in the seminal vesicle why is it that this disease is practically unknown clinically or postmortem? It is only reasonable to suppose that tuberculosis of either of these organs would produce symptoms for which relief would be sought and treatment given. Furthermore prolonged observation of such cases would undoubtedly reveal the actual condition sooner or later. If the prostate or seminal vesicle is the starting point of epididymal tuberculosis why is it that the removal of the epididymis has such a



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Fig. 1. Tubercle of the entire epididym. Tubercle localized in the junction of the vas and the epididym extending for 3 centimeter along the vas.

epididymis. Caulk says: "I have seen any number of prostatic and vesical tuberculous lesions heal after removal of the external genital tuberculosis." Braasch says: "Examination of these patients several years after operation shows that the prostate which was formerly firm and nodular is now much smoother and softer and frequently scarcely palpable. The same is true of the seminal vesicles."

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Barney asks: "If genital tuberculosis arises in the prostate or even in the seminal vesicle why is it that this disease is practically unknown clinically or postmortem?" It is only reasonable to suppose that tuberculosis of either of these organs would produce symptoms for which relief would be sought and treatment given. Furthermore prolonged observation of such cases would undoubtedly reveal the actual condition sooner or later. If the prostate or seminal vesicle is the starting point of epididymal tuberculosis why is it that the removal of the epididymis has such a



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with associated pulmonary lesion and with tuberculosis of the appendix. The addition of the 3 cases of renal tuberculosis without foci in the lungs or other organs gives 54.8 per cent in which tuberculous lesions were associated. These figures are within 1 per cent of Barnes's figures.

If associated tuberculous lesion are not demonstrable a diagnosis of acute tuberculous epididymitis should not be made hurriedly. According to Kelve, when the spontaneous infection of an epididymis suggests tuberculosis one must beware of accepting this suggestion until at least 3 months have elapsed to prove that the infection will not get well spontaneously. If unless there are confirmatory lesions elsewhere in the body or acid fast bacilli can be expressed from the prostate or vesicle or obtained from the urine, one cannot be sure that any lesion of the epididymis is caused by any lesion of the internal genitalia. A usually tuberculous until the 14th months without spontaneous cure prove it.

Indication in the present Stevens said. Early cure (under 1 month) of tuberculous and non tuberculous epididymitis have about an equal extent of involvement of the prostate and vesicle. A time elapses these organs in the presence of tuberculosis continue to give palpable evidence of disease in about the same proportion of instances as is found in the earlier cases whereas in simple inflammation they tend gradually to become normal on

palpation. Hence marked involvement of the prostate and seminal vesicles after epididymitis has existed over a month is evidence in favor of tuberculosis. After 6 months it becomes a very strong argument for this diagnosis.

The prostate was involved in 5 per cent of cases. It was described as irregular firm and nodular occasionally one had softened areas. In cases there were abscesses.

Involvement of the vas deferens was noted by the examining physician in 35 per cent of the case. It was described as a hard pipestem like thickening with nodulation in proximity to the epididymis.

The history of previous epididymectomy, orchidectomy or the incision of scrotal abscesses has justly been considered as strong evidence that any lesion of the remaining epididymis is probably tuberculous. The presence of a discharging sinus is almost pathognomonic although in some instances it may indicate gumma. Tuberculous sinuses are usually posterior while those from gumma are more likely to be anterior. In our series 97 of the patients had received surgical treatment previously—58 incision of scrotal abscesses, 6 epididymectomy and 33 orchidectomy—and 108 patients had discharging sinuses (74 surgical and 34 clinical). The sinuses had been draining for from a few days to several years. A tendency was noted in many cases to abscess formation and drainage followed by spontaneous healing then recurrence several months later. In most of the 98 cases in the series of 108 in which the abscess was incised the patients were not aware that the process was tuberculous. In the remaining 50 cases the sinuses formed spontaneously or with no more than the aid of local applications.

As the non tuberculous lesions are usually unilateral the presence of bilateral epididymitis probably favors a tuberculous origin.

#### PRIMARY SEAT OF INFECTION

To answer the question regarding which of the genital organs will be involved first in a tuberculous infection appears to be almost hopeless. It is possible that any one of the organs may be initially involved

the main arguments relative to treatment however depend on the settling of this point.

If the epididymis can be shown to be the initial site of the disease the simple procedure of epididymectomy becomes logical. If on the other hand it is shown that the disease originates in the prostate or seminal vesicles the radical removal of the genital tract with out the testicle would be the accepted procedure.

Those who believe that the prostate is the initial site of the disease including Walker who has had a great deal of experience in experimental work point out that when apparently recent tuberculous lesions are found in the epididymis the process is usually far advanced in the prostate and vesicles. They further state that the lesion usually develops in the lower pole of the epididymis where it would be expected that infection by way of the vas deferens would first appear. They have noted similar involvement by gonococci which as shown by Rolnick enter through the lumen of the vas deferens. They ask why a different mode of entry should be advocated for the bacilli of tuberculosis. If lesions of the epididymis are examined microscopically it is found that those in the lower pole seem to be more advanced than those in the upper pole. Although the apparent duration of a tuberculous process does not necessarily determine its priority lesions of the epididymis have been produced experimentally by the injection of the organisms into the urethra in cases in which the testicle has been injured previously.

Young in a most comprehensive article on the subject in which he advocates the radical removal of the entire seminal tract asserts that the primary focus is not in the prostate or epididymis but in the seminal vesicles and quotes Guyon the father of modern urology who believed that the tuberculous process usually begins in the seminal vesicles and that the involvement is from urethra outward toward the external genitalia.

Without overlooking the pathological and experimental evidence brought forward by others Braasch (4) Caulk (6) and Barney (2) all emphasize the striking clinical indications that the infection is primary in the



Fig. Tuberculosis of the entire epididymis. Tuberculosis of the vas deferens at the junction of the vas and the epididymis extending for 3 centimeters along the vas.

epididymis. Caulk says: "I have seen many number of prostatic and vesical tuberculous lesions heal after removal of the external genital tuberculosis." Braasch says: "Examination of these patients several years after operation shows that the prostate which was formerly firm and nodular is now much smoother and softer and frequently scarcely palpable. The same is true of the seminal vesicles."

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adulatory effect on the other organ of the genital tract. I have followed a good many cases for a good many year both before and after operation. While there have been occasional exceptions as is to be expected of the prostate and vesicles which were nodular indurated and enlarged before epididymectomy have eventually returned to an essentially normal condition. Barney states that 5 of 6 boys with tuberculous epididymitis who were examined at the Massachusetts General Hospital did not show evidence of the disease in the vesicles or prostate. He quotes Kantorowicz as stating that the prostate was involved in only 5 of 51 children who had epididymal tuberculosis.

Cunningham (5) in a review of 4250 necropsy records at the Boston City Hospital found 35 cases of tuberculosis of the epididymis in which gross and microscopic examination of the epididymis and a gross examination of the prostate and vesicles were recorded. The vesicles were involved in 3 cases and the prostate in 5. He states: "It is seen that in each instance where the vesicle was involved the prostate was involved also and that there were ten instances where the epididymis was the only structure of the tract affected which gives good reason for the belief that the disease is usually primary in this organ."

In our series involvement of one seminal vesicle was noted in 68 cases in all of which the epididymis on the same side was affected. In 16 of the 6 the opposite epididymis was also involved although the vesicle on that side felt normal. The data would suggest that the infection did not travel through the vesicles to the other epididymis but that it was primary in the epididymis and this seems to explain the improvement noted following epididymectomy.

#### ASSOCIATED URINARY INFECTION

A great deal has appeared in the literature with reference to the incidence of genital tuberculosis as a complication of a urinary infection. Braasch (5) in 1920 made a comprehensive review of a series of 234 cases of renal tuberculosis and noted that there was genital infection in 171 (73 per cent) there

were not as many as limits of the percentage of urinary tuberculosis complicating a genital infection.

Barney in a series of 154 cases of tuberculous epididymitis found associated renal infection in 45 per cent. In 100 cases of genital tuberculosis Thomson Walker found accompanying urinary tuberculosis in 37 cases although epididymitis was present in only 73 of the series.

In our series of 300 cases renal tuberculosis was found to be present in 110 (57 surgical and 53 clinical) and developed after epididymectomy in 7. Our observations seem to show at least a 36 per cent chance of the association of renal tuberculosis with tuberculous epididymitis. This percentage is higher than that of other observers but we believe that the recognition of more cases of renal tuberculosis and their surgical treatment explain the lower incidence of late mortality. Since in 35.7 per cent of the 109 cases of bilateral involvement and in 37.1 per cent of the 191 cases of unilateral involvement there was renal infection the chances are that urinary infection would occur whether the epididymis was involved on one or both sides.

In 55 cases in which only one kidney was affected the epididymis on the same side was affected in 23 cases on both sides in 21 cases and on the opposite side in 9 cases. Thus in the presence of unilateral disease of the epididymis and coincident renal tuberculosis there appears to be an overwhelming chance that the kidney on the same side is involved. In 12 cases bilateral renal infection was associated with unilateral epididymal infection.

#### ANALYSIS OF URINE

Microscopic examination of the urine was made in 293 cases and it was negative in 9. Pus cells were found in 137 and in 64 both pus cells and the bacilli of tuberculosis were found. Thirty-six of the latter were in the surgical group and renal tuberculosis was demonstrated in all but 5 cases. Two of the patients died presumably from tuberculosis within 3 years, nephrectomy for tuberculosis was performed 4 years later on 2 patients and the fifth patient died from cardiac disease. It would seem reasonable to assume that bacilli of

tuberculosis are rarely found in the urine in cases of tuberculous epididymitis unless there is also tuberculosis of the kidney. Cunningham states that in many clinical cases in which the vesicles and prostate were typically tuberculous smears of the expressed material show bacilli of tuberculosis in less than 15 per cent of cases examined. In this connection it may be noted that of the 79 cases in which there was dysuria renal tuberculosis was demonstrable in all but 7 and postoperatively only 3 patients aside from the 79 mentioned complained of this symptom when questioned. Dysuria therefore does not appear to be a symptom of genital tuberculosis unless there is coincident renal involvement. In reporting one of the few cases of primary tuberculosis of the prostate discovered at necropsy Koll states that there were no urinary symptoms prior to death. Dysuria therefore must be considered as an important indication of renal involvement.

#### INVOLVEMENT OF THE REMAINING EPIDIDYMISS

Thomson Walker states that if the epididymis on one side is tuberculous the one on the other side is invariably affected after a year or two. In Stevens series of 74 proved cases 25 per cent involvement of the epididymis on both sides was noted on examination and in the series reported from the Massachusetts General Hospital Barney noted involvement of both sides in 29.3 per cent.

In 109 of our cases approximately one third bilateral involvement was noted on examination and involvement of the remaining epididymis was noted in 38 cases the other having been previously removed presumably because of tuberculous infection. Bearing in mind these percentages of bilateral involvement at the time of the first examination it is of interest to note the incidence of recurrence in the remaining epididymis following surgical procedures. Keyes says: "Be the operation ever so slight or ever so radical relapse on the other side almost inevitably occurs." Barney says: "My figures show that relapse is less apt to occur if the first epididymis is operated on." Barney reports only 10.6 per cent of such recurrences in his series of cases.



Fig. 3 Tuberculosis of the testicle and epididymis. The testicle and epididymis have been split to show the miliary involvement of the testicle and caseation of the epididymis.

In our series of 175 surgical cases bilateral involvement occurred in 58. Orchidectomy or epididymectomy had been performed on the opposite side in 26. There was one case of atrophied testicle following mumps and one of an undescended testicle. Thus there were only 89 cases in which it was possible for the tuberculous process to extend to the other side. Eighty of these we have traced. 9 of the patients have died and of the 71 still living 28 (39 per cent) have tuberculosis in the remaining epididymis. It would seem that epididymectomy did not tend to lessen the involvement of the remaining epididymis and yet the fact that in 82 per cent of the cases it became involved within a year after operation indicates the possibility that it was microscopically involved at the time of operation and that the operation was responsible for the low incidence of extension later. Since during the second year only 6.5 per cent were involved and in from 2 to 10 years only 10 per cent after this time involvement was infrequent, single cases occurring at 1, 15 and 17 years later.

#### SINUS FORMATION

Whether or not the operation prevents extension to the remaining epididymis it may remove or prevent a distressing discharging sinus and frequently relieves the patient of a painful focus of disease. Unless surgical



procedure is instituted for the relief or prevention of suppuration it is questionable whether it is indicated. It must of course be followed occasionally in all tuberculous processes by the development of discharging sinuses, the chief object being to prevent this.

In the 175 surgical cases the wound healed within a month in 14 cases and during the first year in 15 more in 8 cases a sinus persisted for 1 years and in 7 years. Several of the patients in reply to our questionnaire volunteered the information that healing did not commence until they exposed themselves to sunlight following which healing was rapid. Myle has shown conclusively in the cure of veterans that heliotherapy causes rapid healing of scrotal sinuses and causes the regression of all tuberculous lesions of the genital tract. He states that the foundation of the treatment is based on the assumption that tuberculosis of the genital tract is a local manifestation of a generalized process and that treatment in order to be curative and permanent must be directed toward the disease as a whole rather than toward local manifestations alone. He therefore confines the patient to bed for 1 years and administers heliotherapy daily. Few patients suffering from tuberculosis of the genital tract could be persuaded or have the means to undertake such an ideal course of treatment nevertheless whenever possible heliotherapy should be used in a association with surgical procedures. If the disease is not far advanced heliotherapy may be substituted for surgery if it is available to the patient economically and geographically where it is not the artificial sunlight of the quartz lamp may be substituted. One of our patients reported that his wound did not heal until he had had such treatment although he had tried heliotherapy previously.

#### REFERENCE

Young, believing the seminal vesicle to be the primary point of infection advocates the removal through a perineal incision of both seminal vesicles and ampullae together with the prostate at the same time removing the vas deferens and diseased epididymis through an inguinal incision. The operation is radical

and Quinby is the only one of the leading urologists who has felt that the disease demands this drastic form of treatment. He reports 6 cases in which he removed the seminal vesicles the procedure did not however always prevent the later development of the disease in the remaining epididymis and in several cases a persistent perineal sinus developed. Young has reported 15 cases with 1 death at the time of operation.

Nine of our patients were treated by this radical procedure 4 of them are dead 4 are living and 1 case has not been traced. The results are not better than those of the more conservative method of removing the epididymis with a portion of the vas deferens a procedure preferred by most surgeons because of the lessened risk and the equally good final results. Hunt says. Even though most patients with tuberculosis of the epididymis have one or more scrotal sinuses the high inguinal incision is preferable to the scrotal incision. The contents of the scrotum are readily drawn up into the incision thus facilitating excision of the epididymis the involved tunica vaginalis and sinus together with the vas as high as the internal inguinal ring. Primary healing of the wound is the rule. Excision of the involved and inflammatory tunica vaginalis is important for early closure of the scrotal sinuses. While castration is sometimes necessary in cases of extensive involvement resection of the testicle is readily accomplished in cases of partial involvement. The frequency of bilateral tuberculosis of the epididymis should condone the promiscuous orchidectomy for either unilateral or bilateral involvement if for no other reason than for its mental and physical effects.

Maveiner followed this method in a series of veterans under government care. He injected the perineal end of the vas deferens with phenol and closed the wounds without drainage. He says Sinus formation is encouraged by drainage and most of these wounds closed primarily and healed like incisions for hernia. Two cases with involvement of the seminal vesicles presenting indurations and swelling to the size of a small orange on rectal examination improved at once after epididymectomy and the pelvic

miss decreased one half in size within a few weeks

The possibility of exciting miliary or meningeal tuberculosis following epididymectomy must not be overlooked. Craik reported

cases in which meningitis developed after simple epididymectomy under local anæsthesia and called attention to the increase in virulence of tumors and infections of the testicle as compared with similar lesions in other parts of the genito urinary tract. In our series there was one death from tuberculous meningitis and one from miliary tuberculosis following operation. It seems inadvisable therefore to operate until the condition has become chronic in order to minimize this risk.

#### PROGNOSIS

The late mortality following either single or double epididymectomy is variously estimated. Berger reported on 46 cases traced from 1 to 25 years. Thirteen patients (9 per cent) had died. Cunningham reported on a series of 32 cases. Seven patients (21 per cent) had died within 10 years. Barney traced 113 cases from 1 to 25 years after operation and found that 7 per cent of the patients had died from some form of tuberculosis. He estimated that 85 per cent of deaths occur within the first 6 years. Young warns against forgetting that many patients from whom replies are not received are dead and that if cures only were included in the estimates of prognosis the percentage would be 19 per cent. Braasch in discussing Young's report calls attention to his review of 34 male patients on whom nephrectomy was performed at the Mayo Clinic 171 (73 per cent) of whom had tuberculosis of the genital tract also. He says: Twenty six patients (18 per cent) were reported dead which is somewhat less than the average mortality of 24 per cent for all patients. Although there was definite involvement of the prostate and seminal vesicles in all of these cases 80 per cent recovered after nephrectomy. It seems questionable whether these percentages could be improved by removing the prostate and vesicles.

Of the series of 175 patients treated surgically 85 (48.5 per cent) are known to be

alive for from 5 to 17 years after operation. 13 others were in good health when heard from during the 5 year period but did not answer the questionnaires. As these were not returned from the postoffice the probability is that they were received and not answered. In this event 56 per cent of patients are alive more than 5 years. Eighteen patients (10 per cent) died from tuberculosis of the urinary tract. Nephrectomy had been performed in 16 of these at the time of their examination. Seven of the 99 patients who were free from renal tuberculosis at the time of operation later contracted the disease. Fifteen patients (8.6 per cent) died from pulmonary tuberculosis. In every case its presence was known at the time of operation but was not considered far enough advanced to be a contra indication. Four patients (2.2 per cent) died from other forms of tuberculosis making a total of 1 per cent of cases in which death was attributed to tuberculosis. Seventeen patients (9.7 per cent) died from unknown causes. Fourteen cases (8 per cent) were not traced and 9 patients (5.3 per cent) died from various unrelated diseases.

If we consider that all patients not heard from have died from tuberculosis and exclude the 9 who died from other causes there is 61.3 per cent of good late results which as we have said may be attributed to the large percentage of cases of renal tuberculosis discovered at the time of examination and the prompt surgical treatment. This seems to be further emphasized by the low incidence of later deaths: 10 per cent from renal tuberculosis and the fact that in 56 of the surgical cases nephrectomy was performed in 10 prior to operation on the epididymis in 38 at the time of examination and in 8 subsequently. In proportion as these cases of renal tuberculosis were overlooked it is apparent that the late mortality would have been increased. Of the 8 cases in which nephrectomy was performed after the patients left the clinic the bacillus of tuberculosis was found in the urine in 3 at the time of examination but operation was delayed in 3 the urine was infected but there were no acid fast bacilli and in 2 urinalysis was negative. All the patients are alive and well. In 2 other cases in which

there were acid fast organisms in the urine and nephrectomy was not performed the patients have died from renal tuberculosis. This emphasizes the importance of a careful microscopic examination of the stained urinary sediment. Neglect of this measure will we believe affect the final mortality rate in cases of tuberculosis of the genital tract since there are so few cases in which the bacilli are found in the urine without renal involvement.

#### NON SURGICAL CASE

A comparison of the results obtained following operation was made with the course of the 15 non surgical cases. Forty two patients (3 per cent) not operated on are alive from 5 to 17 years after examination only 7 of these have found operation necessary of the 6 returned to the Mayo Clinic for epididymectomy. Epididymectomy was performed on one elsewhere and orchidectomy on 3. The other patient decided to resort to more radical measures and the entire seminal tract was removed. He is still alive but 13 subsequent operations have been performed on the genito urinary tract. The remaining 35 patients reported that they are cured 5 of these were troubled for a time with discharging sinuses all of which have healed without surgical intervention. Of the untreated patients 30 per cent died subsequently from some form of tuberculosis. This incidence is one third greater than in the surgical group and might be used as an argument in favor of surgery except that the group is composed of many cases in which because of advanced tuberculous lesions elsewhere surgery was not advised as well as many cases in which it did not seem wise to operate because of the slight involvement of the epididymus. Forty of our patients had atrophy of the testicle following operation and 30 did not so we believe a 4 to 3 chance that the testicle will atrophy following epididymectomy must be carefully considered. Since in addition there appears a 39 per cent possibility of extension to the other side with the necessity of a second epididymectomy the possibility of bilateral atrophy would seem a serious contra indication to surgery. If

suppuration and annoying pain or weight are absent and heliotherapy is available operation should not be urged. Operation seems to affect sexual efficiency only slightly as 7 patients complained of diminution and all were asked specifically concerning it. Fertility of course is greatly affected although the belief that bilateral epididymitis means sterility does not always hold. One patient who was advised to have double epididymectomy refused and later became the father of 2 children. In the surgical group 6 patients on whom unilateral epididymectomy was performed have had children and 5 among the non surgical cases report offspring although disease of the prostates of 8 of the 11 was sufficient to be evident on palpation. The greater number of the patients are of course sterile.

#### CONCLUSIONS

We believe this study shows that

- 1 Dysuria is a symptom of urinary tuberculosis and does not occur when the disease is confined to the genital tract.
- 2 The presence of the bacilli of tuberculosis in the urine indicates renal involvement.
- 3 Unless the urine is microscopically negative cystoscopic examination should be made in all cases of chronic tuberculous epididymitis.
- 4 Satisfactory late results may be expected in more than 60 per cent of cases.
- 5 It may be expected that epididymectomy will be followed by involvement of the opposite epididymis in 39 per cent of cases.
- 6 Usually involvement of the opposite side will occur within one year of the epididymectomy.
- 7 There is a 7 per cent chance of the development of renal tuberculosis after operation and
- 8 Conservative treatment epididymectomy and heliotherapy offers a better prognosis than more radical measures.

#### BIBLIOGRAPHY

- BARN J D G t l t b l mal h b d  
T Am A G t U S g 97 S  
Id m C ut I T b ul Ph l d lph L S d  
Feb 9 4 53 579

- 3 BECKETT Quoted by Young
- 4 BRAASCH W I Discussion Tr Am Urol Ass 1910 vii 17
- 5 Idem Surgical renal tuberculosis etiology Am J M Sc 1920 cliv 80
- 6 CALLEA J R Discussion Tr Am Urol Ass 1920 vii 27-273
- 7 CUNNINGHAM J H The treatment of tuberculosis in the male Surg Gynec & Obst 1916 xxviii 385
- 8 Idem The treatment of genital tuberculosis in the male Tr Am Urol Ass 1916 x 168-18
- 9 MYLF N A Heliotherapy in the treatment of genital tuberculosis J Am M Ass 1914 lxxi 1834-1838
- 10 CUNYON Quoted by Young
- 11 HUNT A C The surgical treatment of tuberculosis of the genito urinary tract etc Arch Surg 1914 viii 811-818
- 12 KAYES E L Treatment of tuberculosis of bladder and epididymis South M J 1928 xxi 23
- 13 LEITCH S Primary tuberculosis of the prostate gland Tr Am Urol Ass 1915 ix 367-373
- 14 MAXIMIN S I The present concept of local nodule in the prostate Minn Med 1915 v 215
- 15 OLINBY W C The product of a urologist's clinic Boston M & S J 1920 clxxxii 551-556
- 16 PAVICE H C The mechanism of epididymitis Surg Gynec & Obst 1925 xli 15-20
- 17 SERRAVALLO A I Differentiation between tuberculous and non tuberculous inflammation of the epididymis J Urol 1930 x 85-9
- 18 HUBBARD WALKER J W Surgical diseases and injuries of the genito urinary organs New York Funk and Wagnall Co 1914 xviii p 181
- 19 YOUNG H H The radical cure of tuberculosis of the seminal tract Tr Am Ass Genito Urin Surg 1920 iii 173-269
- 20 WALKER B MacF The paths of infection as found in genito urinary tuberculosis Lancet 1913 i 43-440

# THE REMOVAL OF STONES FROM THE COMMON AND HEPATIC BILE DUCTS IN JAUNDICED PATIENTS<sup>1</sup>

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 I. C.      T. M. C.

THE complete removal of a stone or stones from the common bile and hepatic ducts that are producing biliary obstruction is followed by excellent results in a high percentage of cases. The duration and degree of jaundice resulting from the obstruction apparently does not compromise the result. In some instances diseases of the extrahepatic biliary passages with infection in the gall bladder and stones in the common and hepatic bile ducts usually producing obstructive jaundice have been accomplished by preoperative complications such as subdiaphragmatic abscess, perforation of the posterior wall of the gall bladder into the substance of the liver, cirrhosis of the liver with ascites and pleuroperitonitis and in one case hemolytic jaundice. Measured by the patient's feeling, of well being and relief of pain the results of operation in such cases have been as satisfactory as in the cases of common duct stones without such complication.

Descriptions of surgical technique are interesting but to be valuable they should present evidence to show, by the number of cases as well as by the results obtained, whether such technique will stand the test of comparison.

In a group of 67 cases of obstructive lesions of the common and hepatic bile ducts on which I operated during the last 3 1/2 years it was necessary in 40 cases to remove one or more stones from the common or hepatic bile duct. A period of more than 1 year has elapsed since 1 of the operations and in 10 the results have been excellent. In the other cases the patients have gained in weight and have been free of pain but have had transient light jaundice on one or two occasions. Eight patients were operated on from 1 to 4 months ago all have had excellent results. Less than 12 months have elapsed since 16 patients were operated on and all of them up to the present time have been free of further trouble. Four of the 40 patients died

following operation. One of these was an intensely jaundiced patient with a van den Bergh reaction of 20 milligrams for each 100 cubic centimeters. Failing renal and hepatic function was evidenced by deepening jaundice, increasing coagulation time of blood and blood urea of 70 milligrams. Operation for the relief of the obstruction due to multiple common and hepatic duct stones was performed with the hope that death might be prevented. The patient died however on the fourth postoperative day. At necropsy thrombosis of the portal vein was found. Two patients deeply jaundiced at the time of operation with serum bilirubin of 15 and 12 milligrams died late in the postoperative course. Necropsy revealed that one patient had bronchopneumonia only the common and hepatic ducts had been completely freed of stones. Necropsy was refused in the other case. The fourth patient died of peritonitis.

Strictures of the common or hepatic ducts were the cause of the obstructive jaundice in an additional 16 patients operated on 14 of whom are living free of jaundice and quite well. One of the deaths in the course of stricture occurred in the hospital subsequent to operation. The other patient who died was a woman of 64 on whom an anastomosis of the hepaticoduodenostomy type was performed with only a fringe of normal duct remaining for the anastomosis to the duodenum. She returned home in good condition 3 1/2 weeks after the operation. Twelve months later she died at home of unknown cause, necropsy was not obtained.

There were 11 patients with lesions in the head of the pancreas producing obstruction of the pancreatic portion of the common bile duct on whom cholecystogastrostomy, cholecystoduodenostomy, or choledochoduodenostomy was performed. 6 are living comfortably working and free from jaundice and itching. More than 2 1/2 years have elapsed since operation on one of the patients of this group. He

has gained in weight has been free of jaundice and itching and has worked since the operation. One patient lived for 20 months subsequent to relief of jaundice and itching by anastomosis between the obstructed biliary tract and the stomach. Necropsy by his home physician showed pancreatitis with biliary cirrhosis. Another patient, a man aged 57, had a preoperative serum bilirubin of 15 milligrams. Following a cholecystogastrostomy for the relief of biliary obstruction due to a tumor 7 centimeters in diameter in the head of the pancreas he was allowed to return home 4 weeks after operation. For 9 months he was free of jaundice and itching, gained in weight and was able to work. He died a month later, 10 months after operation.

#### PERIOD OF PREPARATION

Following the work of Hallenbeck and Giffin, who began the preparation of jaundiced patients for operation by the oral administration of calcium lactate and when necessary blood transfusion, Bell and I, after a clinical study carried out in 1911, advised the use of intravenous injections of calcium chloride to prevent postoperative bleeding. Later the toxicity following the intravenous injection of calcium chloride in animals was studied and the amount necessary to reduce the coagulation time of most jaundiced patients (5 cubic centimeters of a 10 per cent solution daily for 3 days) was found to be a fortieth of the lethal dose for animals measured by grams for each kilogram of body weight. From the experimental data of Opie, Mann and others on the value of carbohydrate over any other type of food if the liver has been injured and function impaired, it was decided that a high carbohydrate diet and a fluid intake of 3,000 to 4,000 cubic centimeters in each 24 hours should supplement the intravenous injections of calcium chloride in the preparation of jaundiced patients for operation. Since that time reports in the literature indicate that this method of preparation has been generally and successfully adopted (1, 3, 4, 7, 11, 13, 14).

In 1915 Seelig suggested that the calcium chloride be given in 15 cubic centimeters of physiological solution of sodium chloride to prevent localized thrombosis at the site of

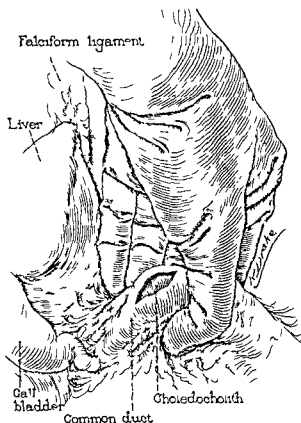


Fig. 1. Illustration of a stone in the common duct. The duct is opened by means of a cut made directly down on the stone.

injection and sloughing of the skin if the needle does not reach the vein. This suggestion was adopted.

McVicar has suggested that repeated determinations be made by the van den Bergh test of the amount of bile pigment in the blood stream and that the presence or absence of the flow of bile into the intestines be determined by duodenal drainage during the period of preparation. The propitious time for operation is when the bile pigment in the blood stream reaches a level, particularly if the bilirubinemia is decreasing. In a few cases under observation and preparation the bile pigment in the blood stream will increase and should it increase progressively the additional risk of delay should be carefully weighed against the prognosis.

#### TYPES OF STONES IN THE COMMON BILE DUCT AND TECHNIQUE OF REMOVAL

In general stones in the common bile duct may be small and multiple and floating in the bile in the common and hepatic ducts. They may be single and floating in the bile in the

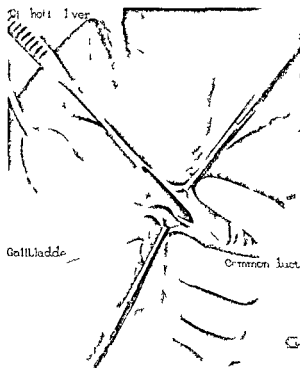


Fig. 1. Instrument inserted into common bile duct.

ampulla of Vater (ball valve stones of Tenger) or they may be large (from 1 to 5 centimeter in diameter) and impacted in the common bile duct below the entrance of the cystic duct. Obesity, adhesions from previous operations, or the massing of tissue from diffuse inflammation in some cases make exposure of the common bile duct difficult. An exceedingly difficult and serious operation can often be made simple and safe if the stone in the common bile duct is located by palpation and if we work from the outer right side of the abdomen toward the duct at a depth of approximately that of the common bile duct rather than directly down on the duct. By grasping the duct and fixing the stone between the thumb and fingers of the left hand, we can open the duct and remove the stone by cutting directly down on it (Fig. 1). I have employed this method in 10 serious cases of biliary obstruction and the rapid uneventful recovery of the patients leaves no doubt as to the advantage as well as the necessity of relieving the cause of biliary obstruction with as little manipulation of adjacent structures

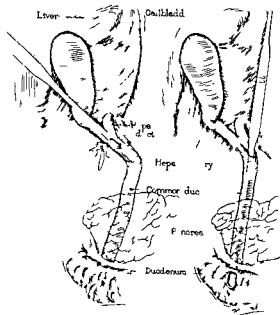


Fig. 2. Instrument inserted into common bile duct especially to remove stones from the gallbladder.

and tissues as possible. As the edges of the duct separate they are grasped with Allis forceps. After the removal of the stone and the fixation of the opening in the duct by forceps, scoops can be introduced easily into the common and hepatic ducts and through the common duct into the duodenum thus removing other stones if present and what is most important making certain that the continuity between the liver and intestine through the extrahepatic biliary tree is definitely established (Fig. 2 and 3).

When stones are present in the gall bladder also, particularly if they are small, their removal before the common duct is opened will prevent the possibility of their being dumped into the common and hepatic ducts during exploration of the latter. It should be remembered that it is usually safer from the standpoint of the patient's recovery to drain the gall bladder in case of jaundice than it is to take the increased risk of cholecystectomy. Should one elect to drain the gall bladder rather than remove it, it interior should be carefully palpated with the finger to eliminate the possibility that any stone remain especially in the cystic duct. In cases in which stones were removed from the gall bladder

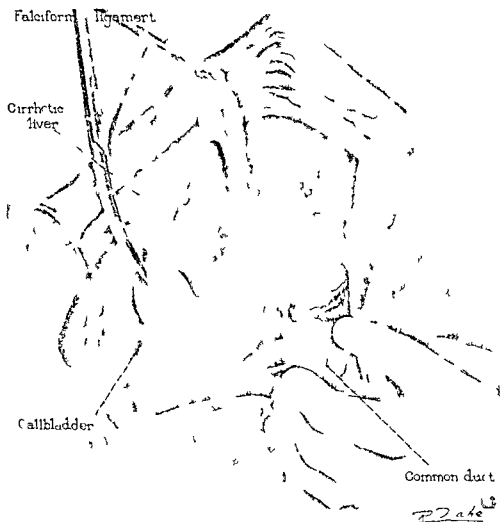


FIG. 4. Exposure of the common bile duct.

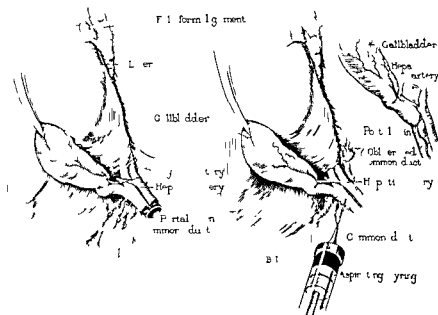
and cholecystostomy was performed after the removal of stones from the common bile duct the patients have done as well as those on whom cholecystectomy was performed.

In the absence of oedema and infiltration from acute cholecystitis exposure of the common duct is comparatively easy. The gall bladder is grasped with a curved haemostat and gentle traction is made on it toward the patient's right shoulder. Two gauze sponges are inserted to hold back the colon and stomach and with a third sponge the hepaticoduodenal ligament is straddled by the first and second fingers of the first assistant's left hand while he tracts downward and to the left on the hepaticoduodenal ligament. In such manner it is possible to expose the common bile duct so that it may be opened under direct vision (Fig. 4). Forceps are then introduced and the stones removed. In such cases the ease of the operation is dependent

on the excellence of exposure of the common bile duct. After the stones are removed from the common or hepatic ducts with scoops or forceps if the size permits it is always best to explore the interior with the finger. By using the finger as a probe one can be most certain that the interior of the duct is clear; this is not possible however in many cases because the duct has not dilated sufficiently.

In a recent case following the removal of a large stone from the common bile duct sufficient dilatation of the ducts made it possible to introduce a finger and carefully palpate the interior of the entire duct. In palpating the lower end of the common duct we found the sphincter of Vater dilated and partially opened to a diameter of approximately 1 centimeter. The notation of this at the time of operation led to the elimination of the possibility of a duodenal fistula on the fourth day following operation when the amount of drain





the from the Mayo Robson hepatic drain which had been placed through the common bile duct varied from 980 to 3860 cubic centimeters each 4 hours during a period of 7 days. Obviously we were dealing with a reflux of duodenal contents through the dilated papilla into the large common bile duct and not with a fistulous tract between the wall of the duodenum and the exterior of the body. This reflux of duodenal secretion ceased abruptly when the Mayo Robson hepaticus drain was removed; the wound healed rapidly and the patient made an excellent recovery.

The most elusive stone is a small one floating in the lumen of the ampulla which cannot be palpated because of its size and the surrounding pancreatic tissue. In such cases repeated colic followed by jaundice or the intermittent hepatic fever of Charcot necessitate exploration of the common bile duct. The introduction of a scoop into the lower portion of the duct is rewarded often by the return of the stone in the scoop. In a few cases in which the stone is not returned by the exploring scoop manipulation through the lower portion of the common bile duct may thrust the small stone through the papilla into the duodenum and its exit occurs through the intestinal tract.

#### SECONDARY OPERATIONS ON THE COMMON BILE DUCT

In cases in which operation has been performed on the biliary passages the connective tissue around the structures in the hepato duodenal ligament may effectively cloak them or disturb their position so that it is difficult to identify the common bile duct. Under such circumstances if the common bile duct is scarred regardless of whether this is due to infection or trauma what would seem to be dilated common bile duct may be the portal vein. An aspirating needle and syringe as recommended by Deaver can best be used in the identification of the common bile duct or its stump (Fig 5). Should the portal vein be punctured the bleeding can be readily controlled by the application of pressure to the needle hole for a few moments. On one or two occasions what seemed most certain to be the distended duct proved to be the portal vein but no harm was done by the puncturing needle. Many such secondary operations are exceedingly difficult and the utmost care must be taken in the dissection of incisions from the under surface of the liver in order not to open them inadvertently. When the common bile duct is intact it will always be found to occupy the most lateral portion of the hepatic

coduodenal ligament and it is best to approach from that side and keep close to and work down on the under surface of the liver. In such cases the discovery by palpation of a stone which is large enough to be grasped in the fingers gives a feeling of attraction because it means certain isolation and identification of the duct.

Following exploration of the interior of the common bile duct a catheter of sufficient caliber to drain bile from the biliary tract temporarily is sutured into the duct. Such a catheter is removed between the tenth and the twelfth postoperative day (Fig. 6). A T tube is best if prolonged drainage of the biliary tract is desired.

#### THE PERIOD OF CONVALESCENCE

If the biliary passages are cleared of stone and ready exit of bile into the intestinal tract or to the exterior is provided during the period of acute inflammatory oedema following operation on the ducts and their contiguous structures convalescence is practically always without incident. If free passage of bile is not provided the jaundice may deepen the coagulation time may lengthen and bleeding from the wound occur. Later if the obstruction is not relieved the train of events leads through hepatic and renal insufficiency to death.

Should a stone remain in the duct or should pancreatitis and oedema of the pancreatic portion of the common bile duct prevent the passage of bile into the intestinal tract and bleeding occur from the wound every effort should be made to attract more drainage of bile to the exterior hence the necessity of temporary drainage of the common bile duct in all cases following the removal of stones. Should bleeding occur from the wound it may be checked by the intravenous injection of calcium chloride or transfusion of citrated blood provided the jaundice is not increasing from continuing obstruction. In one case in which such measures failed the wound was opened and the bleeding from the hepatic notch controlled by the application of a pack of iodoform gauze mixed with powder composed of 8 parts of powdered boric acid and 1 part powdered acetanilid.

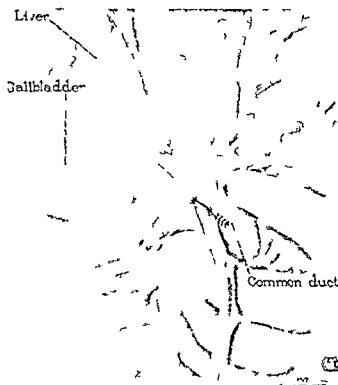


FIG. 6. Drainage of the hepatic duct by Mayo Robson hepatic drainage.

#### BIBLIOGRAPHY

1. DEWEY J. B. Surgery of the common bile duct. *Med. Rec.* 9: 189-913.
2. DEWEY J. B. and BURDEN A. G. The surgical management of the complication of cholecystitis. *Ann. Surg.* 19: 189-380.
3. DOUGLAS JOHN. Structure and operative injuries of the bile duct. *Ann. Surg.* 1926: 189-39-403.
4. HAGGARD W. D. Some debatable points in the surgery of the gall bladder. *Surg. Gynec. & Obst.* 10: 9-96.
5. HALLFENBECK D. F. and CUFFIN H. Z. Personal communication.
6. JUDD I. S. and BURDEN A. C. Obstructive jaundice. *Am. J. Med. Sc.* 10: 189-806.
7. JUDD I. S. and LYONS J. H. The mortality following operation on the liver, pancreas and biliary passage. *Ann. Surg.* 1923: 189-194-204.
8. MANN I. C. Study on the physiology of the liver. I. Technique and general effects of removal. *Am. J. Med. Sc.* 1921: 189-42.
9. McVICAR C. S. Diseases of the liver and biliary passage: the clinical application of some recent investigation. *New York St. J. Med.* 1927: 189-113.
10. McVICAR C. S. and HARRIS W. T. Clinical aspects of jaundice. *J. Am. Med. Ass.* 19: 189-2018.
11. MCKINNON B. G. A. Abdominal Operations. Philadelphia: W. B. Saunders Co. 1916: 4th ed. 11-417.
12. OPIE F. L. and ALFORD L. B. The influence of diet on hepatic necrosis and on toxicity of chloroform. *J. Am. Med. Ass.* 1914: 189-806.
13. PITCHARDSON E. P. Surgical aspects of certain phases of liver function. *Ann. Surg.* 1918: 189-322-357.

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## THE PATHOLOGY OF EPIDIDYMITIS<sup>1</sup>

By HARRY C ROLNICK M D C a c o

THE pathology of epididymitis has been studied fairly extensively both abroad and in the United States. Cunningham and Cook (3) and Kretschmer and Alexander (5) have within recent years presented studies of the pathology of acute and chronic epididymitis in a large series of cases together with a summary of the literature. Very little study has however been made of the pathology of acute epididymitis during the first few days after onset and practically none of the mode or path of extension of the infection in the epididymis.

The experiments to be reported in this paper were undertaken in order to determine the pathological changes in early acute epididymitis and also the route taken by the bacteria in the extension of the infection upward in the epididymis. In 1914 the writer presented before the Chicago Urological Society a theory of the mechanism and pathology of epididymitis (1) that correspond well with many of the clinical facts and some experimental observations.

The inability to inject fluids through the vas deferens beyond the tail of the epididymis (Fig. 1) of experimental animals and also that of the living human is a factor which apparently had not been previously considered. The deductions made from this finding were that bacteria from the infected seminal vesicle traveling along the lumen of the vas deferens in the development of epididymitis are prevented from passing upward along the lumen of the epididymis beyond the tail by the same mechanical or anatomical factors that prevent the forcing of fluid beyond the tail (Fig. 2).

The tail of the epididymis suffers the brunt of the inflammatory process but the body

and head of the epididymis and the other contents of the scrotum are also affected. It was therefore assumed that the infection in epididymitis secondary to seminal vesiculitis is intratubular in the tail of the epididymis that it involves the rest of the epididymis by peritubular and interstitial extension and produces a periepididymitis of the body and head rather than an epididymitis.

Belfield and Rolnick (2) have recently demonstrated excretion by the body of the epididymis (Fig. 3). Although we are not concerned here with hematogenous infection of the epididymis this finding of excretion would indicate that many of the cases of chronic simple epididymitis and many other types of epididymitis are of hematogenous origin. In one of the sections made in this series of experiments secretion by the epididymis a well recognized function is also demonstrated (Fig. 4).

The results of the experiments verify only in part the theory of the pathology and mechanism of epididymitis is just stated. This work which is now presented was done during July and August 1915 and has not been previously reported. A report can be given of a series of experiments on 18 dogs and 4 clinical cases of acute epididymitis which have been studied since then.

The experiments were divided into 3 groups. In all cases the epididymides were injected bilaterally through a visotomy incision with either chemicals or bacteria or both. The animals were destroyed at intervals of from 1 to 8 days following the injection of chemical and at intervals of from 36 hours to 6 days following the injection of bacteria. In those in which the injection of bacteria was followed

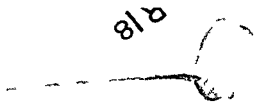


Fig. 1. A roentgenogram taken following the injection of the epididymis of a dog through the vas deferens with a 10 per cent sodium iodide solution and showing the impossibility of forcing fluid beyond the tail of the epididymis.

within a few hours by the injection of chemicals the intervals between operation and destruction or death of the animal varied from 3 to 6 days. Sections were then made of various parts of the tail body and head of each epididymis—164 sections in all.

The 7 dogs in the first series were injected through the vas toward the epididymis with various chemical solutions consisting of 1 per cent protargol, 3 and 5 per cent collargol, 1 per cent mercurochrome and 1 per cent chlorazene. The results of these experiments corroborated the work of Belfield carried out many years ago in which he showed that it was impossible to produce a chemical epididymitis. Since these experiments were conducted experimental work by us on the living human has also agreed with these observations of the failure to produce a chemical epididymitis. None of the solutions could be found in sections of the body or head and were present in the lumen of the tail only. The epithelium of the tubule remained intact even with a 5 per cent collargol solution and none of the solutions could be found in the interstitial tissue. They all remained within the lumen of the tail of the epididymis.

The 7 dogs in the second series were injected in the same manner with bacteria and as previously stated sections were made of various parts of the epididymides of the dogs who were destroyed at intervals of from 36 hours to 6 days following injection. The bacteria were 24 hour growths of stock cultures of bacillus coli, staphylococcus aureus and staphylococcus aureus haemolyticus the virulence of which had been previously determined. The staphylococcus aureus haemolyticus had been fatal to a hospital interne 4 years previously. The bacillus coli was



Fig. 2. Entire seminal duct from tail of epididymis to prostatic urethra injected in the living with iodized oil through vasotomy. Not even a watery fluid could be forced beyond the tail of the epididymis. Note large loop in pelvic portion of the vas. The large shadow above the epididymis is due to urplu oil in the bladder.



Fig. 3. The testis and epididymis of a dog. Silver nitrate phenamine has been injected into it. In the tail of the epididymis show the presence of all the head and tail do not.



Fig. 4. Section of testis showing interstitial inflammation. The tubules are normal in size and shape, but the interstitial tissue is infiltrated with inflammatory cells.

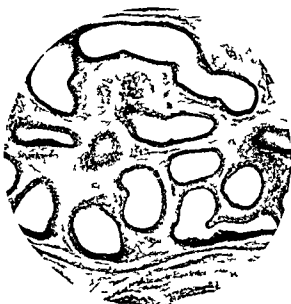


Fig. 6. Section of testis showing tubular inflammation. The tubules are dilated and filled with inflammatory cells, and the interstitial tissue is also infiltrated.

considerably less virulent than the other types. The microscopic pathology did not vary with the different organism except in intensity of infection. Nearly all writers

agree that the pathology of epididymitis in the human varies but little with the different infecting organisms.

The gross pathology found corresponded with that reported by the authors previously mentioned except that the infections due to the *Staphylococcus aureus hemolyticus* were more severe and destructive than that usually seen. Multiple abscesses particularly in the tail and some in the body and head were noted. A fibrinous and purulent exudate covered the tunica in some and the testicle was also involved in a few cases.

The microscopic pathology brought out one finding quite distinctly, that *that the inflammation even in the tail of the epididymis is not intratubular but is peritubular and interstitial* (Fig. 5). It also demonstrated as had been suspected that the involvement in the head and body was interstitial and not intratubular (Fig. 6). This latter had been demonstrated by Andrey and Dilous in 1903 (1) who showed that the extension of the infection in the epididymis was via the interstitial tissue and lymphatics. Although the wall of the tubule in the tail showed considerable edema in some cases and although the tubule

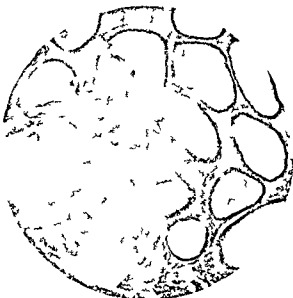


Fig. 5. Section of testis showing tubular inflammation. The tubules are dilated and filled with inflammatory cells, and the interstitial tissue is also infiltrated.

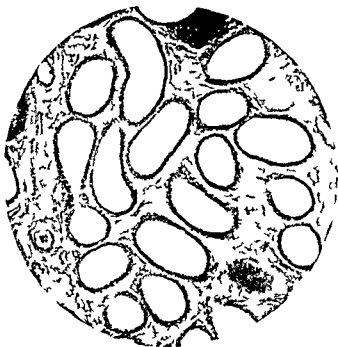


FIG. 7. Section of the body of an epididymis injected through the vas deferens 4 days previously with a 24 hour culture of *Staphylococcus aureus*. An interstitial abscess and round infiltration are shown. There is no intratubular involvement.

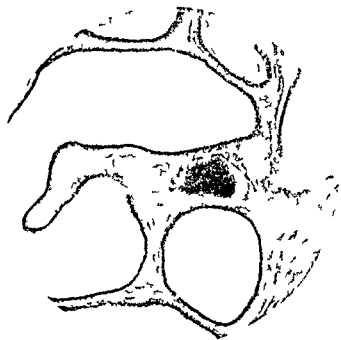


FIG. 8. Marked dilatation of the tubule above the tail with an interstitial abscess but no intratubular involvement. Section of the body of the epididymis which had been injected with *Staphylococcus aureus* 4 days previously.

was often markedly compressed and oedematous; the epithelium was apparently intact. In a few instances there was some leucocytic infiltration in the lumen but here also the epithelium showed very little change. Where large abscesses had formed these were interstitial and had pushed the tubule aside and compressed it. In some cases the tubule was involved and destroyed. In others there was marked round cell infiltration around the wall of the tubule and in some within the wall associated with an oedema of the submucosa and occlusion of the lumen as result of this oedema. In most of the sections areas of round cell infiltration or abscesses were to be seen only in the interstitial tissue (Fig. 7).

The tubule of the body and head was usually somewhat dilated and in others markedly so (Fig. 8) with areas of round cell infiltration or abscesses in the interstitial tissue only. In some sections of the tail near large abscesses the tubule was also distinctly dilated. The tubule above the tail was in some cases filled with sperm. In most instances however no sperm was found.

Nobl (6) and Seller (8) showed that in both acute and chronic epididymitis there is a



FIG. 9. Section of the tail of an epididymis injected with a 4 hour culture of *Staphylococcus aureus*. Eighteen hours later 2 per cent mercurochrome was injected through the vas in the same manner to reach the epididymis and the animal was sacrificed 4 days following the injection of the bacteria. Note the marked round cell infiltration interstitial and peritubular but not intratubular. The dye is shown in the lumen of the tubule the epithelium intact. The anti-septic which did not cap the tubule did the bacteria had no effect on the infection.



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marked increase of connective tissue about the tubule. In chronic epididymitis Delbert and Chavassu (4) showed that tenosclerosis due to contraction of newly formed connective tissue and to epithelial proliferation within the tubule. Wolff (9) showed the peritubular sheath markedly disrupted in acute epididymitis.

The third series of experiments consisted of the injection of the 3 cultures into 4 dogs. This was followed within from 1 to 18 hours by the injection of a 1 per cent mercurochrome through the vas down to the epididymis in the same manner in which the bacteria had been injected. An attempt was made here to medicate the epididymis directly and possibly about the epididymitis.

The gross and microscopic pathology was not different with the injection of both bacteria and chemical than in those in which bacteria only had been injected. The multiple abscess and round cell infiltration peritubular and interstitial were similar to those in which only bacteria had been injected. The tubules of the tail only showed mercurochrome in the lumen; none was found in the peritubular or interstitial tissue.

The last series of experiments verified the previous findings that the primary seat of the inflammation is around and between the tubules and not in the lumen and that direct medication of the epididymis through the vas is therefore of no value.

The last experiments also demonstrate that within a few hours after the bacteria reach the epididymis they penetrate the wall of the tubule by passing between the epithelial cells and rapidly spread to the interstitial tissue. The 4 sections of clinical cases of acute epididymitis 3, 5, 7, and 10 days after onset also showed marked interstitial involvement of the tail but practically no intratubular involvement. In the case of 10 days duration the case was marked epithelial proliferation in parts of the tubule and destruction in a few areas.

This interesting observation that epididymitis in its onset at the tail and in its extension upward is almost entirely a peritubular and interstitial inflammation and not intratubular is of considerable clinical importance. Although these findings do not correspond with many of the descriptions of the pathology made by others who reported considera-

ble intratubular involvement the most likely explanation of their finding is that in most instances the pathology of acute epididymitis was studied in infection that had been present 10 days or more and therefore after destructive changes in the tubule had taken place as the result of compression or abscess or extension from without.

#### SUMMARY

1 It is not possible to produce a chemical epididymitis. This has been demonstrated clinically in that epididymitis does not follow vasotomy except in those cases in which there has been a secondary infection of the vasotomy wound.

Acute epididymitis at its onset consists of an interstitial and peritubular and not intratubular inflammation of the tail as well as of the body and head of the epididymis.

3 The extension of the infection from the tail is via the peritubular and interstitial tissues and not via the intratubular tissues.

4 Direct medication of the epididymis through the vas does not influence the infectious process because the bacteria are in the interstitial and peritubular tissues and in the wall of the tubule and not in the lumen. Chemicals remain within the tubule and do not reach the bacteria.

#### CONCLUSIONS

1 Within a few hours after the bacteria have reached the tail of the epididymis they penetrate between the epithelium, involve the wall and extend to the interstitial and peritubular tissues there to set up the inflammatory process.

2 Occlusions of the epididymis following epididymitis results in the main from interstitial and peritubular inflammation producing compression and destruction from without in acute epididymitis and fibrosis and scarring

from without and within in chronic epididymitis.

3 Epididymotomy does not consist of nicking or incising the dilated tubules of the epididymis presumably filled with pus as often stated for the inflammation is interstitial.

4 Early relief of the tension due to the interstitial and peritubular inflammation is definitely indicated not only to relieve the symptoms and hasten the course of the process but also to prevent destruction and obliteration of the tubule.

5 Epididymotomy should be limited to the tail of the epididymis without incision of the tunica vaginalis. The purpose of the incision is to relieve the tension and provide free drainage from the interstitial tissues.

6 Epididymotomy should consist of one clean incision. The relief of tension and the regenerative capacity of the tubule which has not been destroyed by infection but has merely suffered a clean incision will reduce the incidence of occlusion and the resultant sterility.

7 Epididymotomy particularly from the viewpoint of preventing later occlusion of the epididymis should be performed early within the first few days after the onset of an epididymitis.

#### BIBLIOGRAPHY

- 1 ANDREX AND DALOUS. *Ann de dermat et syph* 1903
- 2 BELFIELD AND POLNICK. Observations on the physiology and therapy of the seminal duct. *J Am Med Ass* 1917 LXXIX 2104-2108
- 3 CUNNINGHAM AND COOK. Operative treatment and pathology of epididymitis. *J Urol* 1922 VII 139-152
- 4 DELBERT AND CHEYASSU. *Ann d mal d org genito urin* 1908 XVI 211
- 5 KRETSCHMER AND ALEXANDER. Surgical pathology of acute and chronic epididymitis. *J Urol* 1923 X 335-352
- 6 NOBLE. *Arch f Dermat u Syph* 1923 LXV
- 7 POLNICK HARRY C. *The mechanism of epididymitis*. *Surg Gynec & Obst* 1925 LXI 150
- 8 SELLEI. *Dermat Ztchr* 1904 VI 237-244
- 9 WOLFF. *Arch f path Anat* 1920 CCXXVIII 227-240



## A CLINICAL INDEX OF MALIGNANCY FOR CARCINOMA OF BREAST

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130 N. 4TH ST.

**B**IOLOGICAL methods of cancer with respect to the degree of malignancy into one of four groups based upon the histology of the tumor. His work has stimulated many others to study groups of cases in a similar manner. Greenough recently published the result of such a study in a series of cases of mammary cancer and reached the conclusion that one could predict with reasonable accuracy the outcome of a case depending solely on such an histological survey. The pathological laboratory of the Memorial Hospital has included for some years a histological part of its report of tissue study, a grading into one of three groups indicating the degree of malignancy of the process. It seemed to us that so much emphasis has been placed upon histological findings that we have lost sight of the importance of clinical data always available for study. Reflection upon this subject has led us to believe that cases of carcinoma of the breast may be graded from purely clinical data which will turn out perhaps in even more accurate estimate of the degree of malignancy than the histology of the tumor can reveal.

A wide variation is found in the clinical setting and course of mammary cancer for the disease may be fatal in a few months or may continue for many years. In our own experience the shortest duration being 5 months and the longest  $1\frac{1}{2}$  years. A marked difference in malignancy exists between tumor of small size which have been present for years and those of rapid growth which have been present but a few weeks or months. A more favorable prognosis should be expected when the disease is thoroughly localized as compared to the outlook when the axillary lymph nodes are extensively involved. Cancer of the breast associated with pregnancy or lactation presents a menacing picture and usually runs a rapidly fatal course. An elderly woman with a well localized process which has shown little growth activity

would be placed in the relatively benign group. A rapidly growing tumor in a young woman would be classified as highly malignant. Upon the other hand a well encapsulated tumor of considerable size even with beginning ulceration but without involvement of axillary nodes is often of relatively low malignancy. All of these considerations should be taken into account prior to treatment in evaluating the degree of malignancy. Such an estimate of the patient's status based on clinical data is important for it may guide the surgeon in the matter of prognosis and determine his decision regarding operation.

Although there are many clinical factors which might be considered it has seemed to us that the four major ones to be used in estimating the degree of malignancy are age, presence of lactation, rate of growth and extent of disease. These are the weighting factors and they alone have been considered in building up what we have chosen to call a clinical index of malignancy. After due consideration the weight which we assigned arbitrarily to each factor was as follows:

Age— $A=2$  Rate of growth— $P=4$   
Lactation— $L=3$  Extent of disease— $E=5$

Each weighting factor was subdivided into gradation factors in a similar manner and arbitrary values (Table I) were given to each.

The clinical index of malignancy for any individual patient is calculated by multiplying the value of each weighting factor by its gradation factor and adding the results as:

$CI M = 1 + 3I_0 + 4R + 5E$   
An inspection of Table I reveals that the smallest possible clinical index is 11.

$CI M = (11) + (310) + (411) + (511) = 11$

The highest possible figure is 55.

$CI M = (144) + (343) + (444) + (544) = 55$

Based upon such a calculation patients may be placed in one of the three grades:

Grade A—11-25—relatively benign

Grade B—26-39—moderately malignant

Grade C—40-55—highly malignant

TABLE I

	Weight factor	Grade factor
Age	A=2	Age { 0 to 55 = 1 41 to 55 = 2 40 or under = 3
Lactation	L=3	Lact { At cent = 0 Pre cent = 3
Rate of growth	R=4	Rate { Slow = 1 Moderate = 2 Rapid = 4
Extent of disease	E=5	Extent { Small 3 cm or less = 1 Large = 2 Node present = 4

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In order to determine the soundness of such an index as a guide to ultimate prognosis we have surveyed 100 primary operable patients from the breast clinic without any attempt at selection. All of these patients were treated surgically with the addition of pre operative and post operative X radiation. Table II shows the gradings according to the clinical index of malignancy and the ultimate outcome.

It is apparent that a reasonably accurate prognosis can be given by the use of the clinical index. Grade A showing 69 per cent alive and well 5 years or more after operation as compared with 34 per cent in Grade B while in Grade C but 1 patient or 4 per cent was without evidence of disease at the end of 5 years.

None of the patients graded A died within the first year and but 2 or 9 per cent within the first 2 years. A large number of the cases in Grade B succumbed to the disease in the first 2 years. 22 per cent dying in the first and 41 per cent within the 2 year period. Of the patients graded C more than one half died within the first year and within the first 5 years 78 per cent had succumbed.

In order to determine whether the clinical or histological grading would furnish a more accurate prognosis Dr James Ewing has graded the same 100 cases based solely upon histological study. He has placed them in one of three grades according to the degree of malignancy (Table III).

TABLE II —CLINICAL GRADING

C d A	Rel lyb g	361 t t
Alive and well	5 years or more	(69%) 18
Dead within	1 year	0
Dead within	2 years	0
Dead within	3 years	3
Dead within	4 years	0
Dead within	5 years	1
C d B	Rel lyb g	361 t t
Alive and well	5 years or more	(34%) 18
Dead within	1 year	11
Dead within	2 years	10
Dead within	3 years	6
Dead within	4 years	3
Dead within	5 years	3
C d C	Rel lyb g	361 t t
Alive and well	5 years or more	(4%) 1
Dead within	1 year	12
Dead within	2 years	7
Dead within	3 years	3
Dead within	4 years	0
Dead within	5 years	1

A study of Table III reveals that in the relatively benign group 52 per cent of the patients were without evidence of disease 5 years or more after operation whereas by the clinical grading 69 per cent of these more favorable patients were alive and well at the end of this period. In Grade II 33 per cent survived 5 years free from disease a figure closely comparable to the 34 per cent obtained by the clinical grading. In Grade III the histological grading showed 29 per cent alive and well at the end of 5 years compared to 4 per cent by the clinical grading. It

TABLE III —HISTOLOGICAL GRADING

C d	Rel lyb g	361 t t
Alive and well	5 years or more	(52%) 1
Dead within	1 year	1
Dead within	2 years	4
Dead within	3 years	5
Dead within	4 years	0
Dead within	5 years	1
C d II	Rel lyb g	361 t t
Alive and well	5 years or more	(33%) 21
Dead within	1 year	18
Dead within	2 years	11
Dead within	3 years	6
Dead within	4 years	4
Dead within	5 years	3
C d III	Rel lyb g	361 t t
Alive and well	5 years or more	(29%) 4
Dead within	1 year	4
Dead within	2 years	3
Dead within	3 years	0
Dead within	4 years	1
Dead within	5 years	2

TABLE IV —COMPARATIVE CLINICAL AND HISTOLOGICAL GRADINGS

(C) l g d g		H I I I g					
G d A		Al d II					
Al d w ll	8	G d I	6				
D d th )		G d II					
D d w th		G d III					
D d th 3	3						
D d w th 4							
D d th +							
G d B		Al d II					
Al d w ll	5	G d I	6				
D d th		G d II					
D d w th )		G d III					
D d th 3	6						
D d w th 4							
D d th + )							
C d		Al d II					
Al d w ll		C d I					
D d th		C d II					
D d w th )		C d III					
D d th 3	6						
D d w th 4							
D d th 5+							

obvious that the histological grading fail to place a sufficient number of the more favorable cases in Grade I. Furthermore it does not draw a sharp distinction between Grades II and III for the figure for these two grades for satisfactory 5 year results are too closely comparable. Grade II 34 per cent Grade III 29 per cent. A much wider divergence should appear to have the gradings of any significance.

In Grade I (histological) 4 per cent died within the first year compared to 0 per cent for those graded clinically and within the first 2 year 2 per cent succumbed to the disease in comparison to 9 per cent for those in clinical Grade I. In Grade II (histological) 29 per cent died within the first year compared to 22 per cent of the clinically graded cases. Within the first years 46 per cent succumbed to the disease while 41 per cent of the patients graded clinically died. In Grade III 29 per cent died within the first year and 50 per cent within the first years in comparison to 50 per cent and 78 per cent for the clinically graded patients.

Table IV matches up the 5 year results in

100 cases and indicates how the patients in each clinical grade were graded histologically. In the relatively benign group (clinical) 10 of the patients remaining alive and well were placed in Grade II on a histological basis. It is evident that these patients should have fallen into the relatively benign rather than the moderately malignant group. Of the patients in Grade B (clinical) two of those remaining alive and well were considered Grade C cases when the histological grading was followed. Of the highly malignant group according to clinical grading 9 of the patients who succumbed to the disease within one year were classified Grade II cases on a histological basis. It seems fair to conclude that the clinical grading made a more accurate selection of the patients than did the histological.

One reason for the failure of histological grading to provide a correct prognosis lies in the fact that different histological pictures indicating varying degrees of malignancy may be found in various portions of the same tumor. The study of a small section may reveal one type of histology while another section may show a much more malignant type of tumor growth. The study of large sections initiated by Sir George Lenthal Cheatle and first used in this country by Mr. Ellis of the laboratory staff at Memorial Hospital demonstrates the marked variation in histological pictures in different portions of the same tumor and shows the difficulty of histological grading for any one patient.

Moreover histological grading fails to provide a correct prognosis because no consideration is given those important clinical factors determining the ultimate outcome of the disease.

From this study no doubt can exist that the histological grading is far less effective in furnishing an accurate prognosis than the clinical grading. We are firmly convinced that the grading of patients based upon the clinical index gives a more accurate estimate of the type of disease and the ultimate prognosis than does any other grading hitherto proposed.

## REFERENCES

- BOESAC Mann et al 195 7 6-73  
 Id m Arch Path & Lab Med 9 6 376 38  
 GREENOUGH R B J C nec R se h 9 5 453 463

## ACUTE PERFORATION OF PEPTIC ULCER

SIGNIFICANCE OF UNUSUALLY HIGH INCIDENCE AMONG SOLDIERS IN HAWAII<sup>1</sup>

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WHEN I first took over the surgical service of one of the large army hospitals in Hawaii I was astonished at the relative frequency of admissions for acute perforated peptic ulcer. It was an experience unparalleled in 20 years of practice and led to an investigation of the more important elements of which are herewith reported.

It should be stated at the outset that the subject is approached from a surgical viewpoint and with special reference to its bearing on the military service. The term peptic ulcer is taken to connote both gastric and duodenal ulcer as well as the more recently recognized gastrojejunal or marginal and jejunal ulcer.

After a review even incompletely of the literature on peptic ulcer it seems presumptuous and reprehensible to add to the already voluminous bibliographic incubus. The task of reading, correlating and evaluating what has been written for the last 50 years on only one aspect of the subject, i.e., ruptured peptic ulcer, has been enormous. Speck (9) in 1923 appended 5 pages of bibliography to an article on perforated gastric and duodenal ulcer. Nevertheless contemplation of detached aspects of a subject affords individual pictures a slow motion glimpse as it were and aids in the cinematoscopic vision of the whole subject.

## OBJECTIVES OF STUDY

The two aspects of acute perforated peptic ulcer with which I am chiefly concerned are its incidence and treatment. As a corollary of these however one is inevitably forced to a consideration of the etiology of peptic ulcer in general. It follows then that the objectives of this study may be stated as follows:

1. To demonstrate or disprove the presence of an unusually high incidence of perforations among soldiers in Hawaii.

2. To ascertain whether or not there are any etiological factors peculiar to a Hawaiian environment responsible for the undue incidence

3. To draw such conclusions as may be possible from the report of a small series of cases with regard to the treatment of acute perforations generally and in the military service particularly.

## INCIDENCE

Statistics as to the incidence of peptic ulcer have been notoriously unreliable and are frequently not even mentioned in some of the latest textbooks. A percentage incidence based on clinical cases diagnosed as ulcer and without reference to population is open to many obvious objections. Pathological statistics are more dependable but ulcers frequently heal without leaving a scar and the dividing line between a postmortem ecchymosis or erosion and beginning ulcer is often very fine. Dwyer (1) says that his study of some of the autopsy material (500 cases) of a Philadelphia hospital failed to demonstrate the number of ulcers and healed scars in the duodenum and stomach reported by other observers. He was referring to the report of Sturtevant and Shapiro (10) who found from a review of 7,700 necropsy records of Bellevue Hospital that about 2 per cent of the patients had had either gastric or duodenal ulcer or had evidence of having had an ulcer.

Nevertheless statistics serve as a basis for comparison and I have chosen Morton's (4) figures for this purpose. He says: "Combined clinical statistics show 3.036 cases diagnosed as ulcer among 339,575 patients, i.e., 0.894 per cent. Combined statistics of autopsies of various series show 2,608 ulcers out of 59,450 autopsies, i.e., 4.4 per cent." Morton (4) quotes Robertson and Hargis who found ulcer or scars of ulcer in 18.9 per cent of 2,000 necropsies. Annual reports of the Queen's Hospital, Honolulu, which is the only general hospital serving the civil population of Hawaii list for 1925 of 6,000 cases treated: 14 gastric or duodenal ulcers with a percentage of 0.33

and for 1926 of 6 000 cases treated 7 ulcers with a percentage of 0.45

Table I gives the incidence of peptic ulcer in officers and enlisted men of the U S Army by color and country from 1922 until 1926 the incidence of gastric and duodenal ulcer is given separately. The figures are rates per 1 000 and not percentages.

Table II is a consolidation of the data contained in Table I and consists largely of totals for the 5 year period from 1922 to 1926.

The average incidence of peptic ulcer in the United States Army as a whole for the 5 year period from 1922 to 1926 rate per 1 000 is 0.7. This is about one twelfth of Morton's percentage of clinical cases.

By reference to Figures 1 and 3 it will be seen that the admission rate for peptic ulcer in Hawaii is decidedly below the same rate for the entire army. A further comparison with the admission rate for white enlisted men serving in the United States shows that with the exception of 1924 peptic ulcer has been less common among soldiers in Hawaii.

This finding might be criticized on the ground that peptic ulcer has not been diagnosed as frequently in Hawaii as in the United States were it not for the fact that there is a close correspondence between the rates for each year by country and total army. Again the medical officer personnel of the military hospitals in Hawaii has been changed on an average of at least twice in a 5 year period. This reduces the personal element in diagnosis to a minimum.

The greater incidence of peptic ulcer in the civil population as compared with the military service is readily explained by several factors. Among the most important of these are the age limits of service in the army which are 18 to 64 years with an overwhelming predominance of individuals who are in the third decade of life or who fall into the last years of the second decade. Then too officers and enlisted men must pass a strict physical examination before entry into service.

#### INCIDENCE OF PERFORATION

The consensus of opinion of most authors is that acute perforation complicates peptic ulcer in about 1 per cent of all cases. However the

percentage of perforations in this series of 496 cases of ulcer which occurred in the U S Army during the years 1922 to 1926 is less being 8.87 per cent.

Table III gives the actual numbers by country of annual admissions for perforated ulcer in officers and enlisted men in the U S Army as well as the percentage of ulcers rupturing. Analysis of this table shows a consistently greater percentage of perforations occurring in peptic ulcer in Hawaii as compared with the United States with the exception of the year 1922. During that year but one ulcer was reported from Hawaii and no perforations. Figure 4 graphically portrays the comparison.

The percentage of total ulcers perforating during the 5 year period from 1922 to 1926 in enlisted men in Hawaii was 33.3 per cent as compared with 7.77 per cent in the same class of soldiers serving in the United States.

Tables IV and V give the total percentages and incidentally bring out the fact that where as in 1921 out of 41 ulcers ruptured in 1926 1 out of 7 ruptured.

#### SUMMARY

From these statistics one may conclude that

1. Peptic ulcer occurs one half times more frequently among white soldiers serving in the United States but perforates four times more frequently among soldiers in Hawaii.

Peptic ulcer is steadily on the increase in the United States Army.

3. The percentage of ulcers which perforate that is to say acute perforations has increased almost sevenfold since 1920.

#### SIGNIFICANCE OF HIGH INCIDENCE OF PERFORATIONS

It has been generally agreed that climate season and altitude have no relationship to the development of peptic ulcer or to perforation of an ulcer. Annual admission rates from disease in the U S Army for the last decade published by the Surgeon General prove that Hawaii is the most healthful country of any in which white troops serve including the United States.

The climate in Hawaii is subtropical but cooled by trade winds it is equable and with

TABLE I—INCIDENCE OF ULCER OF THE STOMACH AND OF THE DUODENUM PER ONE THOUSAND OFFICERS AND ENLISTED MEN BY COLOR AND COUNTRY

	0.2		0.3		0.4		0.5		0.6	
	Numb	Rat	Numb	Rat	Numb	Rat	Numb	Rat	Numb	Rat
Off	9	64		00		18	5	44	4	3
White Enlisted	5	7	5	9	9			6	9	34
Europe		38								
Philippine Islands									2	47
Hawaii				5		00		5	4	3
Pacific					3	41		5		3
Colonial United States			3	68		4		5		
English									1	4
Pacific Islands								9		
Total Army	36			7	6	9	34	2	4	3
Off		50	8	7	6	3	3	4	3	64
White Enlisted	9		3	33	15	4	53	6	43	59
Europe	3	3								
Philippine Islands				51						
Hawaii			4		7	6	4	3	6	45
Pacific	3	45		5		9	5	73	4	6
Colonial United States				1	3	7		5		5
English										4
Pacific Islands								8		
Pacific Islands										46
Total Army	46	1	7	36	73	5	78	57	9	69
Grand Total	8	56	69	53	99	73		8	34	

The following table shows the incidence of ulcer per one thousand officers and enlisted men by color and country for the years 1925 and 1926.

out distinct seasonal variations. A slightly lower mean annual temperature and increased precipitation prevails at the army post of Schofield Barracks which is situated on an upland plateau 900 feet above sea level. All other army posts in Hawaii are virtually at sea level.

Among soldiers in Hawaii for the years from 1922 to 1926 7 out of 10 70 per cent of the perforated ulcers occurred at Schofield Barracks. Of the 3 remaining perforations 2 were in one individual who sustained a ruptured gastric ulcer and 3 months later a perforated duodenal ulcer. But since about 61 per cent of all troops in Hawaii have been stationed at Schofield Barracks and since their

annual admission rates from disease have been in the proper proportion the significance to be attached to climate and altitude in this connection is minimal.

In Hawaii only the rates for diseases of the eye and ear and the skin and cellular tissues such as refractive errors conjunctivitis otitis cellulitis trichophytosis and other skin diseases exceed the admission rates from disease for the United States troops serving in any country. The influence of the usual etiological factors of peptic ulcer as infections endocrine disturbances dysfunction of the nervous system and associated diseases is certainly reduced in Hawaii. This has been evidenced by a low incidence of peptic ulcer but the inex

TABLE II—ANALYSIS OF FOUR HUNDRED AND NINETY SIX CASES OF PEPTIC ULCER OCCURRING IN THE U S ARMY DURING THE PERIOD FROM 1922 TO 1926

T t l l	496
C t	6
D d l	336
T t l l	7
C t	97
D d l	39
T t l l	309
l l t d m	3
l l t d m	4
l l t d m	95
T t l l	99
C t	86
D d l	4
T t l l	7
C t	7
D d l	7
A g S i f j t ul h t l t l	3
A g S t p f j pt l l l l t l	68
A U S at p f j t ul wh t l t d	48
H w t p	

plicable thing is that more ulcer perforate in Hawaii

The American soldier takes with him to service in overseas stations his own food and drink and lives under conditions as similar as is possible to those in the United States. The staple articles of the soldier's diet in Hawaii are much the same as in the United States. Certain fruits indigenous to Hawaii such as the pineapple banana papaya avocado etc. are undoubtedly eaten to a greater extent than in the United States. However acute gastritis and diarrhea from this cause are almost unknown and the tropical dysenteries do not occur. Although definite proof is lacking it is probable that the pineapple contains a digestive ferment similar to pepsin from the papaya. Papain resembles trypsin in its properties but acts in an acid alkaline or neutral medium. It is possible that the ferments may be a factor in causing perforation of ulcers by autodigestion of ulcerous areas but hardly probable that they can initiate an ulcer.

The habit and social customs of the American soldier on foreign service are the factors chiefly affected by a changed environment. Exact figures are not available but reliable estimates from company commanders medical officers and individual soldiers are that go

per cent of the soldiers in Hawaii are habitual smokers. Estimates of the proportion of soldiers who indulge in alcoholic liquors are not so reliable because the habit is rigorously frowned upon by the military authorities and because procurement of liquor is illicit.

The average annual admission rate from alcoholism per 1000 of troops serving in Hawaii for the period from 1922 to 1926 is slightly lower than the rate for troops in the United States but the number of admissions to the hospital or the number of men excused from duty for alcoholism is not an index of this vice. It is well known that many soldiers indulge during the hours off duty and under circumstances which do not come to official notice. Chaplains welfare workers company commanders and medical officers agree in the estimate that 60 per cent of the soldiers in Hawaii are occasional drinkers that 30 per cent are habitual drinkers and that 20 per cent use alcohol intemperately in that they indulge to the extent of a spree or debauch at least once a year.

The impure character of the illicit liquor consumed is of far greater importance than the actual amount. There are some few conditions under which medicinal or commercial alcohol can be and has been converted to beverage purposes. During 1926 at Schofield Barracks 6 soldiers died and were rendered almost blind from drinking bay rum containing wood alcohol.

The form of alcohol most easily available to all is the so called okolehao or oke which is peculiar to Hawaii. Another form of liquor which is cheaper and of lower alcohol proof is a fermented beverage colloquially known as swipes. Okolehao is ordinarily distilled from fermented rice although it was originally made from the ti root mash. There are all grades and qualities of the liquor but it is evident that being made for a quick sale and a safe getaway there can be no guarantee of its purity or age.

A common practice is to improve its appearance and taste by allowing sticks of charcoal to remain in the white product for a few days and then adding caramel or other coloring matter. Another method which is even more questionable is to wash the liquor with solutions of

TABLE III—ADMISSIONS FOR PERFORATED ULCERS OF THE STOMACH AND DUODENUM AMONG ENLISTED MEN IN THE U S ARMY AND PERCENTAGE OF RUPTURES

P f t d l of t mach	Off	E l s t d m n								T t l U S a m y	
		U r d s t i		H w		P h l p p i		I l d		I m	
		N m b	I	N m b	P e n t	N m b	P e n t	N m b	P e n t	N m b	P e n t
9			4								5 55
9 3										3	3 6
9 4		3	5							33 3	5 9
9 5			8 33		5						4 7
9 6		8	7 6		5		1			5	8 6
T t a l		6	1 7	4	5	5	5			2	16 3
P f t e d u l f d d e m											
9					5					2	4 5
19 3			5 6		8 5					4	5 47
19 4		4	7 4							5	6 4
19 5										5	7 7 6
19 6	1	4		2	33 3					8	18 5 36
T t a l		8	4	6	7 3		31 3			18	5 36
G r d t t l		4	7 77		33 3	4	44 4	4	5 4	44	8 87

potassium permanganate. These processes are called 'aging the product'. In a great many instances even this is dispensed with as the white article finds a ready sale to a larger if not better choice clientele.

Swipes as its name indicates is of humbler origin. It is a fermented drink made from pineapple parings, cane juice or a mixture of any of the fruit juices.

The psychic reaction of soldiers to a Hawaiian environment is worth at least passing notice. In the first place Hawaii is generally reached by the recruit after a rail journey and sea voyage of approximately a month's duration counting the delays in embarkation de pots and ports. The voyage at sea is not overly conducive to a settled frame of mind as it has been a succession of contacts with new associates in unfamiliar surroundings and with the usual discomforts of ocean travel.

During the period of mental adjustment to a new environment many recruits suffer with nostalgia and overindulge in smoking or take up the habit anew. I believe that smoking and drinking in soldiers in Hawaii is at first but an expression of mental unrest. The danger is that later they may find that they have formed definite habits. It is not for want of

better amusements that a great many soldiers in Hawaii drink and smoke to excess. It is but the natural consequence of a new environment where they find the means at hand.

Attention may be called to the fact that water famines existed at Schofield Barracks for several months during the spring and summer of 1924 and 1926 although water was plentiful elsewhere on the island at that time. At the Schofield Barracks however water

TABLE IV—PERCENTAGE VARIABLES OF TOTAL PEPTIC ULCERS IN THE U S ARMY PERFORATING DURING THE PERIOD FROM 1922 TO 1926

	P e r c e n t
Peptic ulcers perforating	8 87
Gastric ulcers perforating	16 30
Duodenal ulcers perforating	5 36
Peptic ulcer enlisted men in U S Army perforating	7 77
Peptic ulcer enlisted men in Hawaii perforating	33 30

TABLE V—ANNUAL PERCENTAGE OF TOTAL PEPTIC ULCERS PERFORATING IN ENLISTED MEN IN THE U S ARMY DURING THE PERIOD FROM 1922 TO 1926

Y	P e r c e n t	C
1922	43	1 out of 41
1923	7 4	1 out of 14
1924	0 09	1 out of 11
1925	8 03	1 out of 12
1926	4 17	1 out of 7



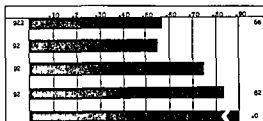


Fig. 1. 100% 92% 90% 82%  
 d l f t i d d m mb d (p pt ul ) p  
 d fl d l t d m tl U S \ my d g the  
 p d f m q t q o

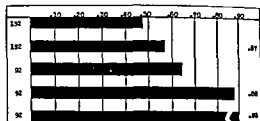


Fig. 2. 100% 92% 90% 82%  
 d l f t i d d m mb d (p pt ul ) p  
 d fl d l t d m tl U S \ my d g the  
 p d f m q t q o

water used which is usually considered non-potable in that it contained organic impurities such as algae and bacteria. In addition the water was unpalatable and may have been irritative from excessive amounts of chlorine iron rust mud or sediment. There is no reason to believe however that the iron rust or lava particle which consisted largely of silicates of iron and manganese was productive of gastro intestinal irritation. Iron rust in drinking water is frequently encountered without any ill effect.

The chlorine content of the water during the famine period was never greater than three parts per million. Although this amount of chlorine is much higher than that ordinarily used to treat drinking water in the United States it is the usual amount added to the water at Schofield Barracks. The bacterial count during the last period of water shortage at Schofield Barrack never went above 15 colonies of colon bacilli per cubic centimeter.

In any event the incidence of perforated ulcers at Schofield Barracks as compared with other army post in Hawaii and the civil population of Hawaii is quite in proportion to the troop stationed there.

Direct trauma in the form of blows on the stomach and long continued epigastric pressure as in shoemaker and horseshoers has always been considered a factor in the production of a gastric ulcer by a stomach tube. Powers (7) reported the rupture of a silent ulcer from external trauma but it is much more probable that the frequent internal trauma of the mucosa from dietary errors is more important. In a susceptible individual continued dietary errors can but aggravate an

ulcer prevent its healing and possibly be the direct cause of rupture.

Soldiers are supplied a well balanced diet of adequate calories through the ration savings method according to Gessner (3). It is a common practice however for soldiers to patronize liberally the lunch stands and short order restaurants. The particularly pernicious feature of this habit is the eating at late hours of a variety of food which is both untimely and generally indigestible.

It has seemed to me that the most significant fact with regard to perforated ulcers among soldiers in Hawaii has been the large percentage of acute ulcers. In a series of 10 cases which were studied 4 of the soldiers gave an entirely negative gastro intestinal history prior to rupture and 1 had had slight digestive symptoms for only 2 months. In half of the cases then the first symptoms of ulcer were those of perforation. One can only conclude that these were very probably acute ulcers.

It is well known that acute ulcers are common and may cause such few or minor symptoms as to escape notice entirely. Sturtevant and Shapiro (10) in an analysis of 7,700 necropsy records found that of 86 open gastric ulcers 24.4 per cent were acute. Fenwick (2) cites 20 per cent of 11 cases as being acute.

Ordinarily the greater percentage of acute ulcers heal readily and the patient is unaware that he was ever threatened. It is only the susceptible individual the one in whom the usual factors of safety are lacking who develops a chronic or true peptic ulcer.

There is one aspect of experimental ulcer which many investigators have observed and which seems worth mentioning in this connection and that is the relative frequency of per-

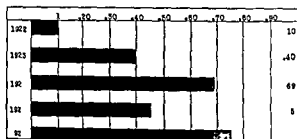


Fig 3 Annual admission rates for ulcer of the stomach and ulcer of the duodenum combined (peptic ulcer) per 1,000 white enlisted men in the U.S. Army in Hawaii during the period from 1922 to 1926

forations in acute experimental ulcer as compared with the rare occurrence of this complication in subacute and chronic ulcer or in advanced stages of an acute ulcer

It seems to me that if half of the perforated ulcers occurring in soldiers on duty in Hawaii are acute ulcers, some particularly acute irritating factor or combination of factors must be at work to produce acute erosions of a high degree of severity. Most of these lesions heal since the incidence of chronic ulcer in Hawaii is far below that for other countries but on account of their acuteness and the severity a large number perforate.

Since the time of G. de la Tourette (11) alcohol has held a place in discussions of the cause of peptic ulcer. It has been generally admitted to have a more important effect in causing perforation since many perforations have been preceded by an alcoholic spree.

Moynihan (5) is convinced that excessive smoking results in hypersecretion and is an undoubted cause of ulcer.

#### CONCLUSIONS

1. Peptic ulcer occurs half as frequently among white soldiers in Hawaii and perforates four times as frequently as among enlisted men of the army serving in the United States.

2. The number of peptic ulcers and the percentage of ulcers which perforate has appreciably increased in the United States Army during the period from 1922 to 1926.

3. The factors which are responsible for the high incidence of acute perforated peptic ulcer

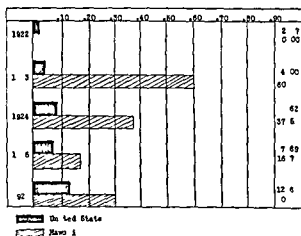


Fig 4 Annual percentage of perforating ulcer of the stomach and of the duodenum combined (peptic ulcer) in white men in the U.S. Army in the United States and Hawaii during the period from 1922 to 1926

among soldiers in Hawaii are fundamentally psychic and include nostalgia, mental depression, lowered nerve tone, excessive smoking, and most important of all the excessive use of impure alcoholic beverages.

I take this opportunity to thank the Surgeon General of the U.S. Army for permission to report the cases. I am indebted also to the Surgeon General for the statistical data incorporated in this article and for valuable assistance in their preparation and correction.

#### REFERENCES

1. DEWEY, JOHN B. and REIMAN, STANLEY P. Pathology and treatment of gastric and duodenal ulcer. *Am J Surg* 1927 33: 333-339.
2. FENWICK. Quoted by Sturtevant and Shapiro.
3. GEISNER, I. J. The United States Army ration. *Mil Surgeon* 1917 16: 67-78.
4. MORTON, C. B. Observations on peptic ulcer. *Ann Surg* 1917 11: 207-238.
5. MCNICHAN, B. G. A Duodenal Ulcer. *Med Philadelphia* W. B. Saunders Co. 1912.
6. OSLER, WILLIAM and McCRAE, THOMAS. *Modern Medicine* 2d ed. Philadelphia: Lea & Febiger 1914. p. 175-200.
7. FLOWERS, H. W. Perforation of silent ulcer of duodenum from external trauma. *Surg Gynec & Obst* 1915 21: 84-87.
8. SCHWARTZ, G. Perforation of gastric ulcer by stomach tube report of case. *J Am M Ass* 1923 18: 150.
9. SPECK, W. Report on 4 gastric and duodenal ulcers. *Beitr z klin Chir* 1923 85: 537-594.
10. STURTEVANT, M. and SHAPIRO, L. L. Gastric and duodenal ulcer. *Arch Int Med* 1926 26: 42-56.
11. TOURETTE, G. DE LA. Quoted by Morton.

# CLINICAL SURGERY

FROM THE ORTHOPÆDIC SERVICE IN COITS HOSPITAL MANCHESTER

## THE OPERATIVE TREATMENT OF TRAUMATIC ULNAR NEURITIS AT THE ELBOW

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S. H. y S g A. H p l C l l L t O t h p d S g r y U y f M h

**W**HLA nerve trunk lies in close relation to a skeletal structure it occupies a somewhat hazardous position. Classical examples are the musculospiral nerve in the groove on the humerus and the lowest trunk of the brachial plexus as it crosses the first rib (or more particularly a supernumerary rib).

The *ulna nerve* is also subject to the same potential disadvantages in its short course behind the elbow. During each movement of flexion the nerve is slightly stretched but its normal elasticity and mobility allow it to respond to changes in tension without incurring damage. This compensatory mechanism is most easily upset if either the nerve trunk itself or the bed in which it lies be injured. Under such conditions a traction or friction neuritis may be induced by repeated unforced movements of the elbow. A neuritis is even more readily evoked in an anchored nerve if forced movements of the joint are used at certain stages in the treatment of the elbow injury.

The ulnar nerve may also be affected adversely if its mobility be exaggerated, an anomaly which exists in a certain unknown number of individuals. The humeral nerve usually slips forward on to the epicondyle but not beyond it during flexion of the elbow but continues to do so with impunity. If however the dislocation becomes complete and occurs with each movement of flexion the nerve is almost certain to sustain damage. Here again a friction neuritis is provoked.

The lesions in which a disturbance of the normal relation between the nerve and its bed is of etiological importance are mainly incomplete and thus may be described under the title *Traumatic Neuritis*.

The following clinical groups may be distinguished in these lesions

- 1 Primary neuritis
  - a Simple contusion
  - b Complicating
    - internal epicondyle fractures
    - supracondylar fractures
    - dislocations of the elbow
- Secondary neuritis—complicating
  - fractures of the lower end of the humerus
  - dislocations of the elbow joint
- 3 Delayed neuritis
  - a Late ulnar palsy—a sequel of *external condyle fractures*
  - b Recurrent dislocation of the nerve

In the treatment of the milder forms of neuritis conservative measures often suffice. When the injured nerve is put under the conditions of complete rest by prohibiting all movements of the elbow spontaneous recovery is usually seen. This is true of the average ulnar neuritis associated with recent fractures of the humerus. But in severe and persistent forms of neuritis operation gives the best chance of rapid cure. For late ulnar palsy or the neuritis due to recurrent dislocation conservative treatment has little to offer and operation is always the method of choice. In complete lesions of the ulnar nerve at the elbow where there is incongruity between the nerve and its bed an ideal *neurolysis* is available: the operation of *anterior transposition* in which the nerve is displaced to the front of the elbow and implanted in a new bed. By this means the course of the nerve is shortened and with each movement of flexion is relaxed instead of stretched as formerly.

Anterior transposition has a still wider application in the treatment of ulnar nerve injuries as a whole for the additional relaxation obtained when the elbow is fully flexed makes it possible to achieve end-to-end suture in grave lesions with loss of continuity. In the peripheral nerve surgery



Fig 1 Reversed position of the limb for operation on the ulnar nerve  
 Fig 2 The skin flap reflected The ulnar nerve lying on the triceps  
 Fig 3 Incision of the nerve in the upper arm  
 Fig 4 Exposure of the nerve in the forearm The line of division of the aponeurosis  
 Fig 5 Splitting the line of fusion of the two heads of the flexor carpi ulnaris

Fig 6 Exposure of the nerve in the forearm is shown completed  
 Fig 7 Fusiform neuroma which is located just proximal to the groove  
 Fig 8 Construction of the nerve bed First stage incision of flexor aponeurosis  
 Fig 9 Construction of the nerve bed Second stage, division of the muscular fibers and division of the internal intermuscular septum

of the late war this technical maneuver was used in a considerable proportion of ulnar nerve sutures (50 per cent in the writer's series<sup>1</sup>)

#### OPERATION OF ANTERIOR TRANSPOSITION OF THE ULNAR NERVE

*Position of the limb* (1) It is usual to place the outstretched arm at right angles to the body and supported on some form of rest. But in difficult nerve sutures the arm must be brought close to the side in the final stages of the operation—a most awkward change. (2) The writer has used for many years an alternative position

for all operations on the ulnar nerve except when the exposure is to be limited to the lower third of the forearm. The position adopted is simply the one in which the nerve is relaxed to its greatest capacity, i.e. the upper limb is held across the body with the upper arm vertical and the elbow and wrist flexed (Fig 1). The fullest exposure can now be made and when a considerable gap is present the actual nerve repair is easily completed without the slightest change in the position of the limb. The patient's head should be completely hidden by the sterile towels and the anesthetic conveyed by one of the recognized long distance methods (Shipway apparatus Pinson ether bomb)

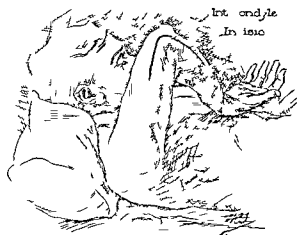


Fig. 1. The internal epicondyle and the insertion of the flexor digitorum profundus.

*Skin incision.* Above the elbow the skin cut is placed just behind the line of the internal epicondyle. At the elbow it lies over the midline of the groove and below is continued in the course of the nerve. A flap is turned back opposite the epicondyle to expose the area in which the nerve lies to be made.

*Exposure of the nerve.* The nerve is approached first above the lesion next below the lesion and finally in the groove itself. In the upper arm the nerve trunk lies in the triceps shows as a white cord through the deep fascia (Fig. 2). The latter is divided carefully from just below the epicondyle and the nerve gently freed for a distance of not less than inches. The fine accompanying vessels (inferior profunda) should be separated from the nerve sheath and preserved. In certain types of neuritis the nerve trunk is abnormally thickened at this level (Fig. 3).

*In the forearm* the deep fascia is divided over the line of insertion of the two heads of the flexor carpi ulnaris in the upper third (Fig. 4). The fibrous intermuscular septa and which the muscular fibers run in from the fascia is split (Fig. 5) and the internal epicondyle of the two heads opened up to displace the flexor digitorum profundus. The nerve trunk is now visible on this muscle belly covered by a thin transparent fascia and is freed as far as the lower end of the groove (Fig. 6).

At this time the proximal branches come into view in the carefully preserved. Although subject to rupture they are usually three in number and originate in the following order: (1) A fine twig supplying the elbow joint arising in the upper part of the groove. (2) A branch to the flexor carpi ulnaris (occasionally two sepa-

rate branches to the constituent heads) and (3) a stout branch to the profundus digitorum.

*In the groove* the deep fascia covering the nerve is divided and the trunk freed by dividing the filamentous adhesions of the nerve sheath to the floor of the groove. The actual lesion is now open to inspection and will correspond to one of the following types: (1) Severe neuritis complicating recent fractures of the lower end of the humerus. (a) The nerve trunk shows little change in contour but is abnormally pale; its sheath is thickened and closely bound to the groove by tough adhesions. (b) The nerve trunk shows a localized constriction or flattening. Proximal to this area there may be a slight fusiform enlargement. (c) An early nerve spindle (fusiform neuroma) may be present. The spindle is usually situated in the upper part of the groove or just above the epicondyle where the latter has been displaced as a result of fracture (Fig. 7). (2) In late ulnar palsy a nerve spindle is always found if the signs of neuritis have existed for some time. A similar lesion is also seen in recurrent dislocation of the nerve. (3) In the graver lesions associated with compound injuries (gunshot or civil) a variety of changes is seen.

*Transposition of the nerve.* The nerve trunk freed from its bed in the whole extent of the wound is drawn forward over the epicondyle. It will be seen that the nerve cannot be displaced far enough at this stage as it remains tethered by the proximal branches. The uppermost branch to the elbow joint should be divided as its value is negligible but the two muscular branches must be conserved. It is possible to achieve this and at the same time free the parent trunk—(a) by stripping up the branches from within the sheath of the nerve and (b) by stripping them in their intramuscular course. By this delicate maneuver the branches are artificially elongated. The ulnar nerve now falls easily in front of the epicondyle with the branches running backward under slight tension.

*The nerve bed.* It is unsound practice to leave the transposed nerve in a subcutaneous position as recommended by a number of writers. The bed should be fashioned in an intramuscular plane. A suitable bed is provided by dividing the aponeurosis and superficial muscular fibers of the common flexor origin from the epicondyle. With the arm in the reversed position and the elbow flexed this incision forms the base of a triangle with the epicondyle as its apex (Fig. 8). At its distal end the incision divides the epicondylar head of the flexor carpi ulnaris just proximal to the point of entry of its motor nerve. The nerve

trunk is now placed in the intramuscular gutter and the area of the lesion deeply buried (Fig 9). There remains a most important step before the nerve is finally hidden by suture of the deeper parts of the wound. As it leaves the upper arm the nerve tends to be kinked or bowstrung on the edge of the internal intermuscular septum. This structure is therefore cleared on each aspect and generously excised where the nerve crosses (Fig 9).

Care must also be taken to prevent kinking of the nerve as it turns downward to continue its course in the forearm. An alternative method of burying the transplanted nerve is available in lesions in which resection and end to end suture are necessary. Instead of the flexor muscular fibers being divided a tunnel may be made through which the two ends of the severed nerve are drawn.

*Closure of the wound* The divided aponeurosis is sutured over the transposed nerve the condylar head of the flexor carpi ulnaris is repaired and the split in the latter muscle is closed as is shown in Figure 10.

*After treatment* The elbow is slung in moderate flexion for 10 days and mobility of the fingers is encouraged from the first. The treatment adopted in the later stages depends on the associated bone or joint lesion.

#### RESULTS OF THE OPERATION

Anterior transposition of the ulnar nerve fulfills all the canons of the ideal neurolysis. This operation has been carried out by the writer on more than one hundred occasions for the various indications already enumerated and with results which are most gratifying.

## FROM SECTION LARYNGOLOGY ORAL AND PLASTIC SURGERY MAYO CLINIC

A TWO-STAGE LARYNGECTOMY<sup>1</sup>

BY GORDON B. NEW, M.D., F.A.C.S., ROCHESTER, MINNESOTA

If it becomes necessary to remove the larynx because of malignant growth it is of first importance to remove the growth completely and to guard the patient against reaction. The result should be a tracheal opening which does not require the use of a tube. In the old two stage operation of Crile the patient usually was obliged to wear a tracheotomy tube. The one stage operation of MacKenzie, while overcoming this disadvantage and being technically more simple, requires a great deal of postoperative care from surgeon and nurses. The two stage operation I am now using seems to combine the advantages of both of these operations without the disadvantages of constant close postoperative care, drainage tubes, and frequent irrigations necessary in the one stage operation and the occurrence of tracheal stricture in the old two stage operation.

Thyrotomy and excision is performed without the removal of cartilage in cases of carcinoma involving the anterior two thirds of the vocal cords without fixation, the grade of malignancy, the age and general condition of the patient being taken into consideration. Laryngectomy is performed in the more advanced cases with fixation.

During the three year period from 1915 to 1927 inclusive 171 patients suffering from carcinoma of the larynx have been examined in the Mayo Clinic and 64 of these have been operated on. In 17 instances thyrotomy and excision were carried out and in 42 laryngectomy was necessary. This group includes certain extrinsic cases but not the epiglottic or postcricoid cases in which lateral pharyngotomy following the method of Trotter might be performed. There were 5 explorations. Tissue obtained at biopsy was examined the day previous to the operation in all cases in which laryngectomy was to be performed.

The operation I am now performing has been a gradual evolution from the old two stage laryngectomy. Before the first stage is performed a Rehfuess tube is passed into the oesophagus through the nose for feeding purposes. Local infiltration of 0.5 per cent solution of procaine is injected in the median line of the neck from the chin to the manubrium laterally to the trachea and larynx and deeply in the region of the hyoid bone. A median line incision is made extending from just below the symphysis of the lower jaw to just above

the manubrium (Fig. 1). Sharp retractors are placed in the upper part of the wound and the hyoid bone is exposed and divided in the median line by means of bone forceps (Fig. 2). Sharp retractors then pick up the ends of the divided bone on both sides and retract them laterally. This allows the larynx to come up into the wound and simplifies the completion of the dissection. Blunt retractors are placed in the lower portion of the wound the muscles are separated and the isthmus of the thyroid gland divided. The larynx and the two upper tracheal rings are skeletonized anteriorly and laterally (Fig. 3). The skin on both sides is sutured to the areolar tissue anterior to the second tracheal ring. The wound in the skin is then closed with dermal sutures, the upper portion of the trachea being left exposed. The trachea is not opened. A split rubber tube is placed at the lower extremity of the wound which completes the first stage of the operation (Fig. 4).

The reaction is much more severe from the first stage than from the second although the wound is clean and the trachea has not been opened. The temperature usually rises to 101 degrees F the first night and gradually drops to normal about the fourth day. A barrier to the soft tissues of the neck is created thus preventing later infection of the neck and mediastinum from the tracheal or pharyngeal secretions. The day the temperature reaches normal the trachea is anesthetized by the injection of 10 per cent cocaine between the tracheal rings into the trachea and a disc of cartilage removed from lower margin of cricoid cartilage to allow the tracheal secretions to infect the wound. This opening may vary in position upward or downward depending on the site and extent of the growth. If it is possible to save the cricoid cartilage an opening is made in the cricothyroid membrane. If the growth extends well down in the larynx the tracheal opening may be made below this point. The patient becomes immunized to this type of infection from the trachea and at the same time the trachea becomes accustomed to the air passing directly into it. Four days after the trachea has been opened the larynx may be removed without the usual reaction.

In the second stage of the operation paralytic block anesthesia together with superficial

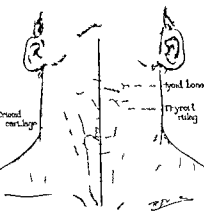


Fig 1

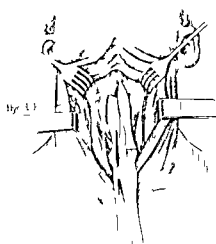


Fig 2

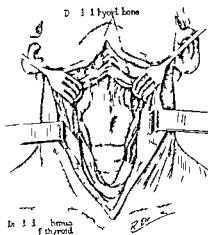


Fig 3

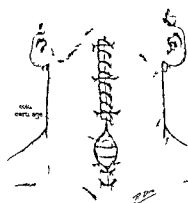


Fig 4



Fig 5

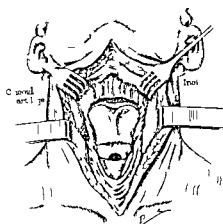


Fig 6

Fig 1 Median line incision

Fig 2 Forceps dividing the hyoid bone in the median line

Fig 3 Sharp retractors have picked up both ends of the divided hyoid bone. The isthmus of the thyroid gland has been divided and the larynx and upper trachea have been skeletonized anteriorly and laterally.

Fig 4 Closure following first stage. The dotted line indicates where the bulk of cartilage is removed about 4 days following the first stage.

cervical block (1) is used. A small amount of the anæsthetic agent is infiltrated on both sides of the wound in the median line. The wound in the neck is freed usually by means of the index finger, the outline of the larynx and trachea being followed. The cut ends of hyoid bone are retracted by sharp retractors. Blunt retractors are placed in the lower portion of the wound and the neck is freed as at the completion of the first stage. The mucous membrane of the upper part of the trachea is anæsthetized through the tracheal opening by means of swabs soaked in 10 per cent cocaine. A small tenaculum picks up the cricoid cartilage and

Fig 5 Second stage. The wound has been freed as at the completion of the first stage. The trachea is cut across. The arrows and syringe indicate the infiltration of procaine back of the larynx for anæsthesia and hæmorrhage. The inset indicates the possible conservative removal of the larynx, leaving the lower portion of the cricoid to be sutured to the skin.

Fig 6 The incision above the larynx is made to obtain a few of the growth from above before it is completely removed.

lifts the larynx into the wound. The trachea is then cut across usually above the first tracheal ring. If it is believed to be possible, the lower two thirds of the cricoid cartilage may be saved thus affording a much larger cartilaginous ring to which the skin may be sutured (Fig 5). As soon as the trachea is cut across, 5 per cent procaine is infiltrated back of the larynx. This controls oozing and anæsthetizes the pharynx at the point difficult to control by block anæsthesia. The larynx is dissected free posteriorly by means of Mayo dissecting scissors almost to the region of the arytenoids. If the growth extends posteriorly



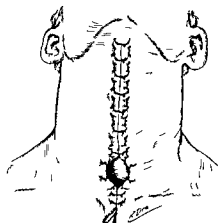
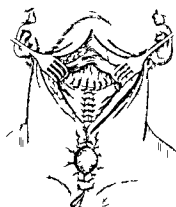


Fig 6 (l ft) C t m t t e t u r l g t l y n T l t r h e a u  
t d t t h l k f t l l t h k g m t t s t e s A m a l l  
p l t r u b b t l t d l l t h t h e a l p d l g g l l p l a c e d  
b t h d f t h w u d t l m t e t h p c u p d b y t h l y n

and there is any question as to its extent at this point the thyroid membrane is cut across and this part of the larynx inspected as suggested by Mackenty to make sure that the growth may be well excised (Fig 6). The removal of the larynx is then completed.

The pharyngeal opening is closed with two rows of continuous mattress suture of chromic cutgut with turning in of the mucous membrane (Fig 7). The lower two thirds of the margin of the incision in the skin on both sides is pared and any superfluous fat removed. The skin is then sutured around the margin of the tracheal opening with silk sutures. The upper part of the wound is closed with silk mattress sutures. The wound in the neck is closed completely. One split rubber tube is inserted at the lower part of the wound below the tracheal opening. Roll of gauze are placed perpendicularly on the neck on both sides of the incision with pressure in order to fill in the space left by the removal of the larynx and to support the pharyngeal wound. They are held in place by means of adhesive plaster (Fig 8). A tracheal tube is inserted.

Following this stage there is usually a slight reaction. The temperature returns to normal in from 4 to 5 days (Fig 9 to 11). The dressing of the part of the wound above the tracheal opening is not changed for 4 or 5 days then the gauze rolls are replaced and held with adhesive plaster. The gauze dressing below the tracheal opening may be changed as often as necessary. After the fourth day the tube is kept out of the trachea as much as possible. It is replaced if any tendency to swelling develops about the opening.

#### COMMENT

The wound above the tracheal opening as a rule heals nicely. With this method the chance of primary healing between the skin and trachea should be the same as in the one stage operation. There may be some drainage at the lower extremity just above the trachea. The use of silk mattress sutures to close the skin at this point has been of great advantage. Pharyngeal fistula following this method is very unusual. Although there is often a little leakage from the lower end of the wound the sinus tends to close gradually. If a pharyngeal fistula does occur following the procedure it is usually small and obliterates itself on account of the median line incision. Occasionally a few secondary stitches are placed in the lower part of the wound in order to shorten the period of convalescence. I have not seen the serious infections of the neck with sloughing and secondary hemorrhage or the large pharyngeal fistulae that require flaps from the neck for closure such as are described following the one stage operation. The two stage operation is used in cases in which the trachea has not been opened or obstructed. If it is necessary to perform preliminary tracheotomy it is made as high as possible so as not to injure the tracheal ring to which the skin is sutured later.

TABLE I OPERATIVE MORTALITY FROM CARCINOMA OF THE LARYNX 1925 TO 1927

	Cases	Died
Thyroidectomy	7	3
Laryngotomy	4	3
Tracheotomy	5	3
Total	64	3



Fig. 9 Nephrectomy had been performed following larynxectomy. Photograph taken before the patient returned home.

There were 3 deaths following the first stage of the operation and none following the second stage in 4 cases (Table I). One of the deaths was the result of infiltration with procaine of the region posterior to the larynx and trachea.



Fig. 11 Large tracheal opening. The site of the growth made it possible to save the lower two thirds of the cricoid cartilage.

method used in the earlier cases in the second stage as the patient could not swallow he aspirated secretions and death occurred from bronchopneumonia after 4 days. This region is now infiltrated in the second stage after the trachea is cut across. Paravertebral block anesthesia as used for the second stage has been used in the Mayo Clinic in 876 cases (the majority of

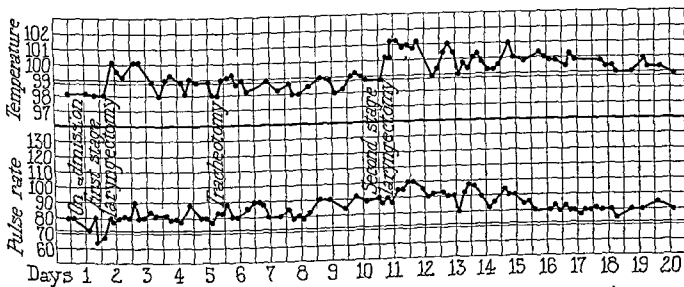


Fig. 10 Temperature chart of the patient shown in Figure 11. Slight reaction from operation is shown.

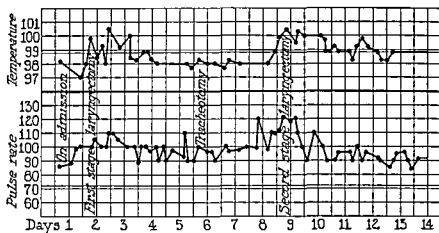


Figure 9 and cat g the slight  
t u n f m the l r y g t m y

which have been bilateral) without injury to the pneumogastric nerves or other untoward results. The second patient who died was a man 70 years of age who had cardiovascular disease the systolic blood pressure was 40 and the diastolic 120. Death resulted from bronchopneumonia following the first stage. The third patient had a cough and slight bronchiectasis the surgical risk was poor. Death occurred from bronchopneumonia after the first stage. If more care had been exercised in the selection of the cases the last 2 deaths undoubtedly might have been prevented.

The points of interest in this method of laryngectomy are (1) the use of local infiltration anesthesia for the first stage (2) the median line incision and splitting of the hyoid bone (3) the creating of a barrier to infection by means of a clean wound (4) the opening of the trachea later to infect the wound and allow the patient to immunize himself and become accustomed to the opening (5) the performing of the second stage

of the operation under paravertebral anesthesia and infiltration of the pharynx about 8 days after the first stage (6) the complete primary closure of the wound of the neck without the usual drains or tubes inserting the split tube below the tracheal opening (7) the application of gauze rolls laterally on the neck with pressure to eliminate the space previously occupied by the larynx and to support the pharynx and (8) the primary healing of the greater part of the wound of the neck and a tracheal opening without the use of a cannula in practically all cases.

#### BIBLIOGRAPHY

- LUNDY J S Bal need a x th M e ta M d  
19 6 399 4 4
- 2 MCKENTY J L Ca c r of the l r y n A h  
Otol ry gol 9 6 5 3 3 5 337
- 3 MEEKER W R Th f p 3 e b al r ve bl l  
x th g l su g y M s ta Med
- 4 T TTE W Su g y f m l gn t d ea e fph r y n.  
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## A NEW METHOD OF INGUINAL HERNIORRHAPHY

WITH LIVING FASCIAL SUTURES OBTAINED FROM THE RECTUS SHEATH

By EDWARD M. HODGKINS, M.D., F.A.C.S., BOSTON

S. g. Ch. f. R. b. r. y. H. p. t. i. l. t. S. g. y. T. f. C. l. l. g. M. d. I. S. h. o. l.

FOR many years there has been a feeling of dissatisfaction among herniotomists with regard to any operation which involves the placing of catgut sutures under tension in muscle tissue. Nevertheless suture of the internal oblique and transposition of the rectus muscle in the repair of inguinal hernia are being continued probably for the reason that no acceptable substitute for this most illogical procedure has yet been offered.

Kirschner's free transplant of living fascia lata to reinforce the suture line of the external oblique aponeurosis was undoubtedly a step forward in fascia surgery but is of limited advantage in herniorrhaphy. McArthur utilized a strip of external oblique aponeurosis to suture the conjoined tendon to the inguinal ligament but the amount of suture material from this source is definitely limited and its quality from the standpoint of tensile strength is always uncertain.

The use of alcohol preserved fascial strips from the ox as advocated by Koontz constitutes a new surgical experiment which is receiving much favorable comment in the literature. It is yet much too early to reach definite conclusions on this method which is undeniably logical in its application and which can be viewed as a possible solution of the suture problem.

Russell and others have even advised that suture of the conjoined tendon to the inguinal ligament is entirely unnecessary and that correct treatment of the hernial sac is sufficient to effect a cure. This however has never been accepted as sound and the majority of surgeons still regard some form of suture as indispensable in the operation.

Gallie and Le Mesurier have made the most important contribution with the recommendation that living sutures of fascia lata be used in place of catgut or non absorbable suture material. They reported that their operations were satisfactory in all details and presented 60 cases of both direct and indirect inguinal hernia of which the majority were stated to be recurrent. None of their patients on careful examination showed any sign of recurrence after 2 years had elapsed. This method has since been used by other surgeons who report very favorable results. Coley

and Burke having used the living suture technique extensively call attention to the increased liability to wound infection experienced by them which seems to be the only adverse criticism of the method so far. The principle is surgically sound and the method will unquestionably remain in favor and gain many adherents. Gallie and Le Mesurier who have conducted thorough and scientific investigation in animals to prove the value of living sutures should be commended for these classical experiments.

In reviewing the literature of the past 10 years on external hernia of all varieties one is impressed with the number of modifications of old operations and the number of new operations that have been invented all with a definite trend toward utilizing fascia more effectively. It is probably now fair to state that subconsciously surgeons in general place little confidence in muscle plastics in the repair of hernial defects and we may anticipate that with further development in fascial suture technique they will evolve a dependable method of performing their favorite operations effectively without any radical change.

All of the commonly accepted methods in use at the present time involve three fundamental principles namely high and firm ligation of the sac closure of the defect in the abdominal wall by suture of the muscle aponeurosis or both to the shelf of the inguinal ligament and the narrowing of the external abdominal ring. It is further more conceded that all three of these principles are essential to any operation that is to be considered complete. There is a large choice of such operations any one of which will prove successful (100 per cent of cures) if the reconstructed abdominal parietes can be made to hold. The future problem is therefore not which operation is best in a given type of hernia but what method of suturing in any of these well planned operations will hold the muscle and aponeurosis unyieldingly and permanently in place.

Working on this premise the writer has evolved the operation of fascial weaving which is a living suture technique and in actual practice has satisfied all of the fundamental requirements for the construction of a firm barrier against recurrence. I submit this report which is distinctly preliminary.

maneuver the loose areolar tissues attached to the flap from the underlying rectus and external oblique fascia

#### EXPOSURE OF THE CANAL

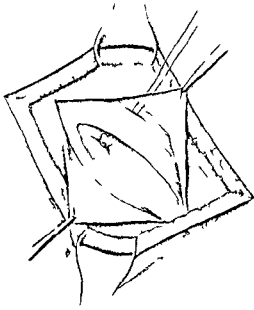
The general plan from this point on of which the importance will be made clear by later description is to disturb the fascia of the external oblique and the internal oblique muscle as little as possible. In the opening up of the fascia of the external oblique care is used not to strip the medial leaf too far back from the edge of the internal muscle as the adherent fascia has valuable tensile strength. The lateral leaf is stripped back to expose the shelf of the inguinal ligament in the usual manner. Barely to define the edge of internal oblique muscle and conjoint tendon gives sufficient exposure.

Isolation and dissection of the sac from cord structures is essentially the same procedure as that described in any standard text on hernia up to the point of treatment of the stump. In this step of the repair the writer prefers the method of transplanting the stump and a slight variation from the usual Kocher technique seems worthy of description.

The sac is opened and inspected and drawn taut. Under direct vision a non-cutting needle carrying No. 2 chromic catgut is passed through transfixing the middle of the sac. This is tied on one side and is then wrapped around and tied on the opposite side. The excess of sac above the tie is next amputated and a few more stitches are whipped over the top of the cut stump. A more secure closure is thereby obtained and the liability of breaking and reopening of the sac as may happen in simple ligation is eliminated. Both end of the catgut suture should be left long and should never be tied together as a knot over the face of the stump may prevent firm adhesion.

A finger is inserted up underneath the arching portion of the internal oblique muscle which is easily separated from peritoneum. With scissors a small aperture is made in the muscle by the careful separation of the fibers in the direction of their course. With a suture carrier or ordinary haemostat the two ends of the catgut are grasped and drawn through the opening and the stump of sac is pulled all the way through. Needles are now threaded onto the two ends of catgut which are carried upward through the medial leaf of the external oblique aponeurosis 15 centimeters apart and tied above the stump being drawn up tightly beneath this fascial layer.

The Kocher method of transplanting the stump of the sac just underneath the edge of the in-



Fg Lo gt t to t pl p p t y  
to d w g t mp f tl gh p t t m l  
bh m l f f l h n g b th f of  
te l l ju

nary with the hope that other surgeons will apply the method so that a large number of cases will soon become available for discussion.

#### SKIN INCISION

The skin incision in unilateral hernia must be planned so that the entire width of the sheaths of both recti will be exposed. To accomplish this it is well to begin the incision above the symphysis pubis to carry it directly over the external abdominal ring just lateral to this point to start a curve upward and to continue parallel to and about 1 inch above the inguinal ligament. The incision is then carried higher but should end about 4 or 5 centimeters from the anterior superior spine of the ilium. It will be similar in shape to the bend in a hockey stick. When opened up with the flap reflected and retracted well toward the midline this incision will give the desired exposure of both rectus fascia and inguinal canal. The semilunar incision with convexity downward directly over the external ring is the most convenient approach for bilateral hernia. With either incision an apron-like flap composed of the skin fat and superficial fascia can be reflected upward by a few strokes of the knife. In fact if the incision is first carried well down to aponeurosis blunt gauze dissection will easily separate in one

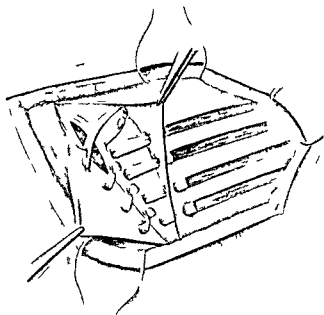


FIG. 2. Steps in method of weaving: (1) Through basal medial leaf of the external oblique aponeurosis; (2) downward through edge of internal oblique; (3) upward through basal portion of inguinal ligament; (4) internal oblique is again pierced from above downward and continuing on loop needle is brought up through fascial strip itself.

ternal oblique muscle was a very important step in herniorrhaphy, but the increased advantages of the method herein described seem obvious.

#### FASCIAL WEAVING WITH THE ATTACHED SUTURES REFLECTED FROM THE RECTUS SHEATH

Certain differences in anatomical relations between the fascial layers of the upper and lower rectus sheath would seem to offer difficulties to the use of fascial strips taken from this source. Below the semilunar fold of Douglas the fascia of the internal oblique muscle ceases to divide at the border of the rectus muscle and together with the transversalis fascia passes entirely anteriorly. A deficiency is therefore left in the sheath of the rectus behind. This fact was thought at first to be a disadvantage, as it seemed that the strips removed from the anterior sheath might lack attachment at the border of the muscle and might not have firm enough anchorage at this point. However, such did not prove to be the case at actual operation. The layers are held at the border by the general solidity of the fascial structure above between and below the area of removal of the strips, with a degree of firmness quite sufficient to withstand any reasonable amount of strain.

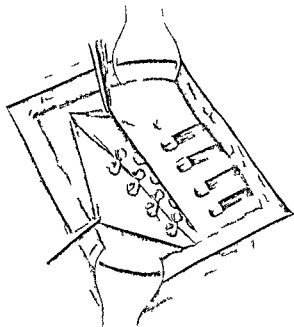


FIG. 3. Sutures have been drawn taut and fixed with linen ties approximating muscle to inguinal ligament. Medial and lateral leaves of the external oblique aponeurosis preserved for imbrication. Knot indicates where stump of sac is anchored.

The technique of the removal of fascial sutures from the rectus sheath requires but little description. Parallel transverse incisions approximately  $\frac{1}{8}$  inch apart are made through the sheath beginning at the lateral border of the opposite muscle and ending at the lateral border of the muscle on the side to be repaired. The strip of fascia thus obtained has been cut in the direction of its fibers and therefore has the desired tensile strength. Light strokes of the knife will facilitate the maneuver of separating the strips from muscle. The strips cut low near the pubis will be short on account of the narrowing of muscles at this point, while those cut higher where the muscle broadens out will be conveniently longer. It can be readily seen that this feature favors the suture requirements of the average hernial triangle, which is narrower below where the conjoined tendon dips downward toward its junction with Gimbernat's ligament. As a general rule not more than four strips will be needed, even though the hernial triangle is large and the internal oblique muscle very much thinned out. In the majority of cases three strips will effect a complete closure. A fascial strip is prepared, threaded into a needle with a large eye and tied into the eye of

the needle with catgut (Gallie technique). Each strip is woven into place as a suture before another is cut.

#### TECHNIQUE OF WEAVING

*First step* The fascial suture is drawn through the medial leaf of the external oblique aponeurosis as close as possible to the line of surgical separation of the aponeurosis and the internal oblique.

*Second step* The edge of the internal oblique muscle is pierced from above downward and the suture is drawn through to the under side.

*Third step* The strip is passed through the shelving portion of the inguinal ligament in the usual manner (from below upward) and is drawn taut.

*Fourth step* The edge of the internal oblique muscle is again pierced from above downward and is picked up just above the first point of suture.

*Fifth step* Finally the needle is brought up through the fascial strip itself. The strip is drawn through and anchored securely at this point with a simple tie of linen or No. 6 chromic catgut.

When the suture is drawn taut in the third step the edge of the internal oblique muscle is approximated to the inguinal ligament without its being cut or undue tension exerted upon it. This particular method constructs a firm loop suture with three points of eventual anchorage: one at its attachment near the border of the rectus muscle, another at the inguinal ligament and the third at the point where it is fixed to itself. Many variations are possible such as the weaving back through the edge of internal oblique muscle slightly to one side of the first weave and then the fixing of the strip to the aponeurosis at another point. Variations in the hernial triangle may suggest advantageous modifications of this sort to the operator.

Although the writer has used the loop method of weaving almost entirely in the cases that have been done, it is perhaps well to mention advisedly that the strips are adequate in length for any conceivable modification of the weaving.

As soon as the necessary number of fascial sutures have been woven through and fastened in place the fascia of the external oblique is ready for closure. This step in the operation also allows some choice. We may imbricate the fascia by sewing the medial leaf to the inguinal ligament either above or below the cord with interrupted catgut sutures placed between the fascial loops and then by overlapping the lateral leaf and suturing it to the superficial surface of the medial leaf. This is probably the better method of

closure as fascia to fascia cohesion is favored and a large proportion of strain is borne by this strong fibrous layer in direct contact with the fascial sutures. When too great tension would be exerted on the medial leaf by an attempt to approximate it to the inguinal ligament, a simple anatomical closure is better.

#### DISCUSSION

Undoubtedly the least dependable step in inguinal herniorrhaphy is demonstrated in the recurrent cases operated upon has been the suture of the internal oblique muscle to the inguinal ligament. The mechanical principle of the building up of a barrier against strain is correct but viewed from a histologic standpoint the surgical principle of suture is absurd. Every case will show that the muscle has pulled away and returned to a normal position so that at the most only a few strands of fibrous tissue are left to represent what was evidently a carefully done repair. This consistent finding proves the inefficacy of foreign suture material in muscle under the tension and pressure of tying. Seelig and Chauke in 1931 claimed to have proved experimentally that muscle would not unite with fascia and they therefore condemned the usual operations for inguinal hernia. Koontz in 1936 confirmed these experiments but added that eroded or cut surface of muscle would unite to fascia. Koontz's 1927 publication in which he recommends the use of alcohol preserved fascial strips from the ox dispels the idea that the author retains much confidence in that phenomenon. Further interesting and valuable evidence found in recurrent cases has to do with the union of the fascia of the external oblique. It is invariably firm and the line of suture can be easily traced by a great amount of fibrous proliferation. Appreciation of this fact has in recent years led to a revival of the Halstead, Andrews, Woolsey and Stetten operations which depend mainly upon fascia for support. Strips taken from the rectus sheath and used as suture material in the deep muscle layers form permanent tendinous strands which will not cut through stretch out or break away from fixed points. Fascia to fascia cohesion is histologically normal and can be depended upon to hold. Fascial strips are therefore ideal suture material. To quote Gallie and Le Mesurier: Over catgut and similar sutures they have the great advantage that they are not absorbed and that they continue for all time to perform the function for which they were originally intended.

The fascial weaving described in this paper offers a method by which the internal oblique

muscle can be fixed either over or under the spermatic cord as may be indicated by the type of hernia. The writer has used a modified Ferguson technique in most of the indirect cases and the Bassini in all of the direct cases imbricating the aponeurosis of the external oblique whenever possible. Indirect herniæ of long standing and with thinned out muscles and a widely dilated triangle also demand a Bassini operation as a rule.

Complete hæmostasis a minimum of catgut ties and sutures avoidance of tension on fasciæ and accurate approximation of layers are features positively essential to the desired firm fascial union. Provided that infection and postoperative pulmonary complications do not arise and that there is no constitutional state which interferes with healing the result will be a solid wound and a permanent cure.

Despite an experience with this operation too brief to warrant a detailed report at the present writing the following observations are submitted.

#### OBSERVATIONS

Fascial sutures reflected from the sheath of the rectus muscles are adequate in length and in tensile strength for inguinal herniorrhaphy.

Not being detached or unduly traumatized the sutures are surely living and have the advantage

of being bathed in normal lymph at all times even during the operation.

Since this method avoids the operation upon the thigh time is thus conserved and the chance of wound infection is minimized.

Fasciæ weaving does not cause muscle necrosis since no tension or constriction is exerted.

#### REFERENCES

1. COLEY B. L. and BURKE C. The operative treatment of hernia by living sutures. *Am J Surg* 1927 **11** 10.
2. GALLIE W. C. and LE MESURIER A. L. The use of living sutures in operative surgery. *Canad M Ass J* 192 **11** 503-513.
3. Idem. Living sutures in the treatment of hernia. *Canad M Ass J* 19 **3** **xiii** 469-480.
4. GIMSON O. L. Operation for cure of large ventral hernia. *Ann Surg* 1920 **lxxii** 214-217.
5. KÖHNITZ A. R. Muscle and fascia suture with relation to hernia repair. *Surg Gynec & Obst* 1926 **xlii** 7.
6. Idem. Dead (preserved) fascia grafts. *J Am M Ass* 1927 **lx** **xvi** 1230.
7. ROWLANDS J. SYDNEY. A new method of obtaining autogenous fascial grafts with an extensive incision. *Practitioner* 1927 **cxix** 321.
8. RUSSELL R. H. Inguinal hernia and operative procedure. *Surg Gynec & Obst* 1925 **xl** 605-609.
9. SEFLIG M. G. and CHAUKE K. S. A fundamental factor in the recurrence of inguinal hernia. *Arch Surg* 1923 **xii** 553-57.



## MUSCLE-FASCIA SUTURE WITH PRESERVED FASCIA AND TENDON

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F m h b b m m l l b o y h p h p l

**I**N the repair of hernia MacArthur was the first to use fascia for the suture of muscle to the internal ligament. He derived his fascia from the external oblique fascia of the patient and used it as a continuous suture device, a special technique for anchoring the ends. Gallie and Le Mesurier have taken fascia lata from the patient for use as muscle fascia and fascia fascia suture using special needles and a special technique for anchoring the ends of the suture. They report excellent results as did MacArthur also.

Koontz has used ox fascia preserved in 70 per cent alcohol as suture material for the muscle fascia suture and has employed a technique similar to that of Gallie and Le Mesurier. Koontz had also done muscle fascia suture with ordinary suture material to determine whether muscle unites to fascia. He was able to show that this does occur by a process of connective tissue union when fat and areolar tissue are previously removed from these tissues. Posenblatt and Cook eventually independently obtained the same results. Seelhorst and Chouke had been unable to secure this union. Hertzler suggests that this difference in results depended on the fibrin reaction being transformed into connective tissue in the cases in which ligatures were tied tightly enough to excite this reaction. Koontz in comparing results with the fascia as suture material found even more firm union than with the ordinary material. It was the work of Nageotte and Nageotte and Sencert on dead grafts that attracted Koontz to their use in the repair of hernia.

Nageotte had assumed that the fibers of connective tissue are inert coagula that preservation in alcohol does not alter their state and that when grafted they will not cause phagocytosis or foreign body reaction because they are implanted among inert fibers of the same kind. Nageotte and Sencert had found in the case of so called dead grafts that (1) the texture of the tissues becomes attached to the grafted part by the ingrowth of fibroblasts (2) a vascular network is established and (3) the dead cells are carried away and replaced by living cells from the tissue of the host.

The experience of Koontz was in entire accord with that of Nageotte and he felt that there was no absorption of the graft. Our experiments were

suggested by the work of Koontz and of Nageotte and Sencert.

We used as suture material alcohol preserved ox fascia and tendon which were prepared as follows: the material was taken from the animal with particular pains to prevent unnecessary handling or contamination of the material. The fascia and tendon were as soon as possible placed in 70 per cent alcohol. Later under sterile precautions the areolar tissue was removed by scalpel and the tissue cut in strips 8 to 10 inches long and 1/8 inch wide. These strips were then placed in a second jar of 70 per cent alcohol and allowed to stand for at least a week. Anaerobic and aerobic bacteriological tests were made on nutrient broth media and in each of the four trials a pure culture of the hay bacillus was found. Experiments are now being conducted in an attempt to eradicate this bacillus from the material. No infection of the animals occurred. With this material an ordinary five eighth curved round needle of moderate size and with a large eye could be made to carry the suture. The suture did not need to have the end tied or sewed to prevent fraying. In using this suture material no special or unusual technique of anchoring or splicing the sutures was necessary for they were placed as individual single sutures. It was found that because of the nature of the material it could be tied more easily with the instrumental technique which we have shown in Figure 1. The end were cut off rather longer than necessary and placed in the groove formed by the muscle and inguinal ligament which had been sutured together.

In our experiments it was decided to adopt a slightly different method than was previously employed in order to suture muscle to fascia under very severe tension and in order to test more adequately what could be expected in the way of union if this undesirable factor was present. In the dog an inguinal incision of 3 inches was made. The external oblique fascia was incised and reflected. The anterior sheath of the rectus muscle was incised at the lateral edge of the muscle and a portion of the sheath resected. This incision of the sheath allowed the internal oblique muscle to fall laterally and to allow a bulge of preperitoneal fat. The edge of the rectus muscle was then sutured under tension to the reflected edge of the external oblique (Pou-

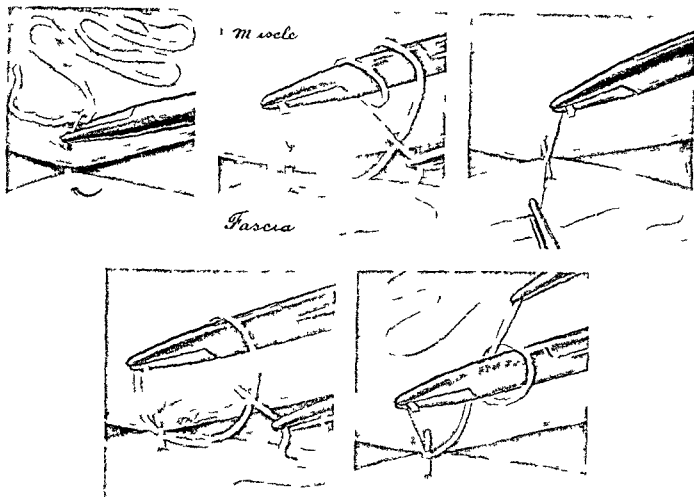


FIG. 1. Muscle and fascia placed in apposition by ordinary curved round needle fascia suture carried by an ordinary curved round needle.

Instrumental method of tying is made desirable by type of suture material used.

part's ligament) by single sutures of fascia or tendon the articular tissue first being carefully removed from muscle and ligament. All the sutures were placed above the internal openings of the cord. (See photographs and drawings of specimens so sutured and the normal anatomy for comparison.) The fascia of the external oblique was then resutured and the skin closed both with catgut.

On several animals tendon was used on one side of the animal and fascia on the other. In one case an autogenous fascia derived from the rectus sheath itself was used. This latter case as well as all of the cases in which dead fascia was used as the suture material showed very firm union of the muscle to the fascia the autogenous being no firmer. It was our impression that the union was even stronger than in our previous experimental work (Rosenblatt and Cooksey) in which the fibrous suture material had not been used. The union was so strong that it would successfully resist forcible attempts to tear it apart. We found the tendinous material

much more difficult to handle at the time of operation because of its inelasticity and hardness and it was much more bulky in the tying of knots. It also traumatized the muscle in several cases, a feature which was not noted in the case of the fascia sutures. The results of the union with the tendon although good were not nearly as good as with the fascia. We therefore feel that the latter is much more desirable for this work.

At autopsy the suture material was evident. The fascia was apparently smaller in dimension than when introduced into the tissue and in several instances seemed very markedly smaller. There were dense fibrous growths between the suture material and the muscle and Poupart's ligament just as between the muscle and the ligament. The tendon on the other hand did not appear to be any different in size than at operation and the fibrous ingrowths were not nearly so marked. It will be remembered that it was previously remarked that the tendinous material was too bulky inelastic and dense for the most satisfactory use in this work.

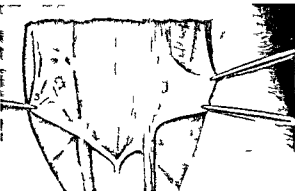


Fig 1



Fig 2



Fig 3



Fig 4

Fig 1. Th l ft d i t d p th ght d  
w t f l d i t m l ft t h th b  
d t d a i t m l l q m le h v p  
p t l f t m d l t R d t d g e o f l p t  
l m t t U f t m l t h l p t l g  
m t t f t p t l f h t h f t u  
m l O f t d  
Fig 3. U f t m l v t h P p t l a  
m t O f t u d h t l o t d n  
t e o l f t 3 S t e t l l d t f t e 6 d y

Fig 2. Th h t l p t d u p o t h l f t w s  
t Th t h t h b d e t d R d t d  
e d g f I p t l g m t d e t f  
d m t a t The t m l f m l y d h t f t r  
f c l t 3 S p m t d & P p t l f t  
5 I t l b l q m l  
I f 5 O t h g l t d e f m o b t e d t h  
f i t O t l e l f t d f m o v a b t e d  
v t l t e d t Th b l k y t e d t m a y b e



Fig 6 Photomicrograph (low power) taken 60 days after operation and showing union of muscle to aponeurosis by means of connective tissue surrounding the muscle fibers and bundles. Ox fascia suture was used.

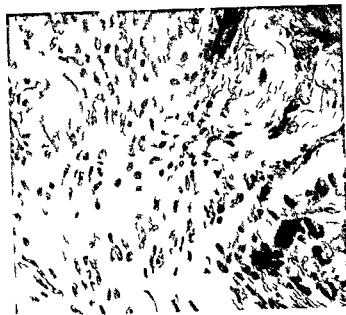


Fig 7 Photomicrograph (high power) of same area as in Figure 6 showing cells of white connective tissue surrounding muscle fibers continuous with those of the aponeurosis—a true connective tissue union.

Microscopically the fascia and tendon grafts had excited some foreign body reaction but practically no round cell reaction. Dense fibrous tissue attachments to the muscle and the fascia and between the latter two elements could be demonstrated. The connective tissue cell having invaded the graft and connected with the endomysium and perimysium (connective tissue) of the muscle. There was a very marked vascular



Fig 8 Photomicrograph (low power) of ox fascia suture through the rectus muscle showing the same type of union as in the two previous plates. There was a slight foreign body reaction in the center of the suture.



Fig 9 Photomicrograph (high power) at one edge of the union shown in Figure 8.



Fig. 1. h. t. m. g. ph. (l. p. i. ho. l. iz. t. ff. l. ft. ll. f. g. l. ly. a. t. m. d. l. w. p. t. f. l. d.

ization of the grafts with tremendous proliferation of the capillaries. It seemed that the fascia graft had acted as an element for substitution of living fibroblasts and had also been in part absorbed. This absorption and foreign body reaction is opposed to the previously mentioned views of other observers.

For clinical purposes we feel very strongly that the use of fascia sutures either living or preserved is not indicated in the ordinary uncomplicated and not unusual hernia. The results are quite satisfactory in most hands by any one of several techniques. We do feel however that

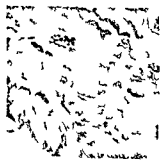


Fig. 2. h. t. m. c. ph. (l. p. ) h. vascu. l. iz. u. ff. w. th. p. ll. j. f. mat. on.

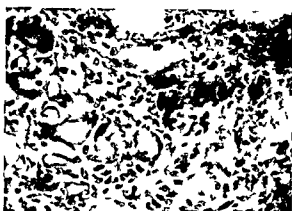


Fig. 3. Ph. tom. j. ph. (l. gl. po. ) lo. gf. n. b. d. r. u. i. i.

there may be certain cases in which very large defects are present, cases with poor musculature or recurrent cases that would offer much greater hope of cure and satisfactory repair if fascia sutures were used. We feel that the preserved fascia suture offers as good repair as possible and is without the inconvenience of requiring a second incision for the purpose of obtaining autogenous fascia material. We have found the method of placing sutures used herein to be very practicable as it requires no special equipment and is rapid and simple.

#### CONCLUSION

1. Preserved ox fascia in muscle fascia suture used in hernia cases gave very excellent union.
2. Preserved ox tendon was not so satisfactory in result or in the handling.
3. It appeared that the fascia graft acted as an element for substitution of connective tissue and was in part absorbed. There was some foreign body reaction.
4. We have used this suture material as a single suture and tied by an instrumental method.
5. We do not recommend the use of this fascia suture except in cases of involved or difficult hernia as we feel that ordinarily its employment is not necessary.

W. d. e. t. h. k. D. P. F. M. r. s. fo. h. d. d. co. l.

#### BIBLIOGRAPHY

- GALLI W. F. and L. F. M. S. C. R. I. A. B. T. I. of l. ng. tu. p. t. u. g. j. C. d. M. l. s. J. 9. 5. 4. > 3. Id. m. l. l. d. exp. t. l. t. dy. of the f. e. tr. pl. t. t. n. of f. a. d. t. d. J. F. & J. t. u. g. a. t. 6. b. Id. m. L. g. t. i. th. t. e. s. t. m. t. f. h. n. Ca. d. M. l. J. 9. 3. 469. 48.

- Idem The use of free transplants of fascia a living sutures in the treatment of hernia Arch Surg 1924 ix 516 529
- Idem The transplantation of fibrous tissue in the repair of abdominal defects Brit J Surg 1924 289 320
- HERTZBERG A L Healing of muscle to bone letter to the editor J Am Med Ass 1929 1098 1099
- KOONITZ A R Muscle and fascia suture with latissimus hernia repair Surg Gynec & Obst 1922 xli
- Idem Experimental results in the use of Jexell suture for hernia repair Ann Surg 1926 lxvii 24
- Idem Dead (pre-erect) fascia graft for hernia repair clinical results Read before the Section on Surgery Gen and Abd at the 78th Annual Meeting of the Am Ass Washn ton D C May 1927 ix 195
- McARTHUR L J Autoplastic uterine hernia and the distal es J Am Med Ass 1921 xxviii 117 124
- NAGOTTE J Essai sur le naturel et la guérison des hernies conjonctives Compt rend Soc 1916 lxxix 1121 1126
- Idem Quelque considérations sur la greffe Iride méd 1920 xviii 626 63
- Idem Il n'y a pas de tumeur amorphe dans la trame conjonctive Compt rend Soc de biol 1920 lxvii 14 49
- NAGOTTE J and SENCERT L Réparation osseuse de l'os par notre méthode de greffe morte de grand pectus de l'abaissement de tendons fléchisseurs de doigt de la main gauche Chez un blessé de guerre Bull Acad de méd 1921 lxxv 449 63
- Idem De la réparation chirurgicale de certains tissus usés par de greffe de tissus morts Prese méd 1918 xxi 62
- Idem Utilisation des tendons morts pour la réparation chirurgicale de tissus de nature conjonctive Compt rend Acad d 1918 clvii 610 1
- PONCELET and COOKSON Muscle fascia suture in hernia Ann Surg 1927 lxxvii 71 77
- SEIFEL M G Fundamental principles underlying the operative cure of inguinal hernia J Am Med Ass 1920 lxxviii 50 53
- SEIFEL M G and CHOUKI K S A fundamental factor in the recurrence of inguinal hernia Arch Surg 1923 vi 553 72
- Idem Tr Am Surg Ass 1923 xli 315 4

## AN OPERATION FOR ANKYLOSIS OF THE HIP JOINT

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It has long been my impression that all of the operations devised to produce ankylosis of the hip in chronic osteoarthritis are unduly elaborate and require an unnecessarily long period of hospitalization. To overcome these objections I have planned a procedure based on the slot and key principle adopted by mechanical engineers in attaching a wheel or gear to a revolving shaft which theoretically at least would produce results with less effort on the part of the surgeon and with considerably less expense to the patient.

An opportunity to put the procedure into execution did not arise until November 1927 when a laborer 54 years of age was admitted to the Hospital for the Ruptured and Crippled with an osteoarthritis of the left hip. Notwithstanding the fact that he had only 10 per cent of normal function in the joint he had for several years worked on the docks as a stevedore until increasing pain compelled him to stop work. His was obviously not a case for arthroplasty, the popular method of treating chronic painful hips because the time element was an important factor and the man had proved that he could earn his living with a practically stiff hip if pain could be elim-

inated. It was therefore decided to attempt the newly planned operation and the results were eminently satisfactory.

The technique was as follows. Through a Smith Petersen incision the upper posterior surface of the acetabular overhang was freely exposed. A tapered block, about an inch square on its superior aspect was cut out (Fig. 1) and put aside in salt solution. The lower extremity was then placed in the desired position of 15 degrees abduction without rotation of the foot and was held in this attitude by an assistant. The tapered opening in the acetabular rim was then extended downward into the head of the femur care being exercised to maintain the slope of the sides of the cut.

The block of bone removed from the acetabulum was then denuded of its articular cartilage and driven with force into the bed prepared for it thus mechanically blocking any movement of the femoral head and bringing the lateral and inferior surfaces of the graft into intimate contact with the raw surfaces formed on the acetabulum and the head of the femur (Fig. 2). A plaster spica was applied without fear of altering the relations between the graft and its bed as the

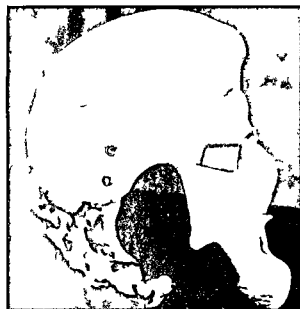


Fig. 1. Specimen of the hip joint after the operation.

joint was securely locked against motion in any direction.

Convalescence was uneventful. At the end of 7 weeks the patient was discharged still wearing a spica. Three weeks later the cast was removed at home and the patient came to the hospital in the subway, the hip joint having become firmly ankylosed and the pain having been entirely eliminated.

In view of the relative simplicity of this operation, the comparatively short time of hospitalization, and the excellent result obtained, the pro-



Fig. 2. Roentgenogram of the hip joint showing the position of the femoral head and the head of the femur.

cedure is offered as a practical means of securing surgical ankylosis of the hip joint, because it has some advantages over methods heretofore described.

## RESULTS IN PORTO RICO OF KONDOLEON OPERATIONS FOR ELEPHANTIASIS OF EXTREMITIES

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THE P. I. C. H. P. I.

THE word elephantiasis has always given the impression of being a tropical disease and rightly so. Nevertheless the reported surgery of elephantiasis has been for the most part one in the temperate zones. In fact the operation that engages our attention in this paper originated in Greece which is about 38 degrees north latitude. Porto Rico at 18 degrees north latitude well within the torrid zone should therefore present an interesting situation for the surgical study of this so called tropical disease and for this reason the results in a small series of cases are presented although they are somewhat at variance with the results reported by our northern colleagues.

Among 19,000 patients admitted to the Presbyterian Hospital San Juan Porto Rico since 1905 there were 53 cases of elephantiasis of the lower extremities. Of these cases 35 have been operated upon. The remainder have either refused operation or have been treated medically. Of the 35 cases operated upon 16 had typical Kondoleon operations either on one or both sides of the leg. 6 had questionable Kondoleon operations (to be explained later) and 11 had amputations either below or above the knee. One patient was operated upon in August 1912 and the warty growths of elephantoid tissue were shaved

off and the raw surfaces dressed with oiled silk. In one case a Kondoleon operation was not completed because of hemorrhage. There has been one operative death in a patient following an amputation.

As defined by Matas (10) elephantiasis is a progressive histopathological state or condition characterized by a chronic inflammatory fibromatosis or hypertrophy of the hypodermal and dermal connective tissue which is preceded by and associated with lymphatic and venous currents in the affected parts. Many operations have been devised to relieve this deforming and disabling condition as these limbs frequently attain an enormous size and make walking almost impossible.

In a review of the operations to date it was found that the first operation—that of ligating the main artery to the limb—was proposed by Carrochian in 1851 and resurrected by Hutter in 1898. Obviously the results of this operation were not encouraging.

Kuzutsoff (1903), Mikulicz, von Eiselsberg, Kasoni, and others have tried the effect of multiple cuneiform excisions of the diseased skin and underlying fibromatous tissue. The results have been favorable in a certain number of reported



Fig 1 (left) Elephantiasis. Amputation was finally necessary.

Fig 2 A front view of the same leg as illustrated in Figure 1.

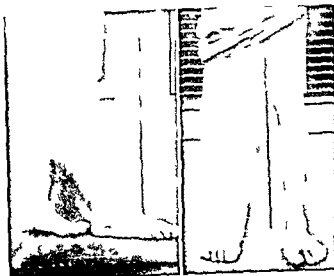


Fig 3 (left) Elephantiasis in a boy 3 years old. A Kondoleon operation was attempted but had to be stopped because of severe hemorrhage.

Fig 4 Same case as shown in Figure 3.



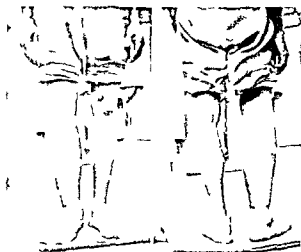


Fig 5 (left) Case 4. The patient operated upon in 1910 was seen April 28, 1917. She had obtained some relief in the area operated upon, but the incisions had only been carried to just below the knee and from there on up to the thigh the disease had progressed as well as in the other leg and attacks of lymphangitis had occurred frequently in both legs. The left calf or leg operated upon then measured 18 inches in circumference while the right calf in which the disease had developed since operation measured 10 5 inches.

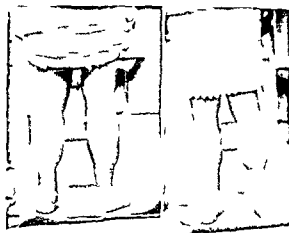


Fig 7 (left) Case 5. The patient operated upon in 1908 since the time of the operation.

cases. Probably 3 of the cases that I have classed as doubtful Kondoleon operations had this type of operation. Two were performed in 1909 and one in 1910. Kondoleon described his operation in 1912. The records of these three operations state that strips of skin and subcutaneous tissue were removed, but no mention of the deep fascia is made. The patient operated upon in 1910 was seen April 28, 1917. She had obtained some relief in the area operated upon, but the incisions had only been carried to just below the knee and from there on up to the thigh the disease had progressed as well as in the other leg and attacks of lymphangitis had occurred frequently in both legs. The left calf or leg operated upon then measured 18 inches in circumference while the right calf in which the disease had developed since operation measured 10 5 inches.

In 1908 Sampson Handley (13) proposed draining the obstructed areas into healthy tissue. This he accomplished by inserting long threads of unabsorbable silk which tunneled the border line between the elephantous and normal tissue. He placed 4 or 5 silk threads in the subcutaneous cellular tissue of the affected limb throughout its length (from the wrist to the chest wall in the upper extremity and from the dorsum of the foot to the abdominal wall in the iliac region in the lower extremity). Varied results were reported. It was soon found that these foreign bodies provoked an overgrowth of tissue around them and functioned as a dam rather than as a drain in some cases. In summarizing the results of the operation Handley himself says: "To my mind

lymphangioplasty has failed to establish its position in the treatment of elephantiasis."

In 1906 Lanz (89) of Amsterdam worked on the theory that only the superficial lymphatics are blocked, attempted to establish a communication between the superficial and deep lymphatics in order to relieve the condition. He proposed an operation which included the opening of the fascia over the thigh, dissection through the muscle down to the bone, trephination of the bone in three places, and the running of strips of fascia through the muscle down to the bone. The result was excellent and 3 years later the patient was in good condition. The technique of this operation is somewhat difficult and Lanz himself later doubted the necessity of trephining the bone.

Kondoleon (67) of Athens, Oppel (11) of St. Petersburg, and Roanow (12) of Moscow modified Lanz's procedure slightly, keeping the principle of drainage of the superficial lymphatics through the deep lymphatics in mind. In 1911 Kondoleon published a description of the operation that we now use and reported very satisfactory results in 6 cases. The operation consists in the removal of a strip of skin and subcutaneous tissue together with the deep fascia from one or both sides of the leg, from the thigh to the ankle, the rent in the deep fascia being left open and the skin and subcutaneous tissue sutured over the muscle.

Matas (10) and Gessner have reported cases of Kondoleon operation in which very good results were obtained. Matas (his patient was the wife of a physician) did the operation on both sides of the leg at the same time. The procedure

resulted in the loss of the leg in one of our cases which I will subsequently mention Gessner's operation was done on the outside of the leg only and improved the circulation so much that old indolent ulcers on the inside healed readily following the operation. One of our cases of amputation was for an ulcer occurring at the site of a Kondoleon operation done elsewhere 6 months previously.

Other cases of the Kondoleon operation have been reported by Hill (5) Royster (13) Herff (4) and Sistrunk (14, 15). Varied results have been obtained by these men but on the whole the results have been more or less satisfactory. Although the condition has not been cured it has either been improved or held in check in the majority of instances. The largest number of cases has been reported by Sistrunk who in 1922 reports 40 patients 30 of whom obtained good results and 10 of whom were improved. He suggests operating the second time in fact states that he has operated upon several patients who had been unsuccessfully operated upon by other surgeons.

In the years 1915 to 1927 16 Kondoleon operations were performed in the Presbyterian Hospital San Juan. Probably 2 of the 6 doubtful Kondoleon operations already mentioned were of this type but since no mention is made of the deep fascia in the record of the operation these cases are not included in our series.

It has been the policy to put these patients to bed for a few days before operation with the leg slightly elevated to allow for as much natural drainage as possible. Since 1919 one side at a time has been operated upon and where more than one strip was to be removed the external strip was removed first and the internal strip last as the internal saphenous vein is ultimately destroyed and it is well to preserve it as long as possible. After operation the wearing of a rubber stocking is advised. It should be put on each morning before the patient gets out of bed.

In the 16 known cases plus 1 case in which an unsuccessful attempt at a Kondoleon operation was made what have been the results? End results in 12 of these 17 cases are known. As mentioned before 1 patient who was operated upon in June 1919 had the operation done on both sides of the leg at the same time and developed a gangrene because too much tissue was removed and because the sutures were too tight. The leg finally required amputation above the knee one month later.

A second patient with elephantiasis involving the foot principally and extending up the leg

about halfway to the knee was operated upon September 8 1921. A typical Kondoleon operation was done and the incisions extended from the head of the fibula to the toes. There was primary union of the wound and the patient was relieved of pain but there was no reduction in the size of the foot when the patient was discharged from the hospital 35 days after the operation. This patient has not been seen since.

A third patient a boy of 13 years since birth had had an enormous elephantiasis of the right leg extending from the hip to the ankle and measuring 14 inches in circumference above the knee and 6 inches at the calf. He was operated upon December 15 1925 after 40 days of rest in bed with the leg elevated. The operative record states: Kondoleon operation attempted and incision outlined. Dissection of flap started just above knee on lateral side. Tourniquet applied by two different people to thigh above incision failed to suppress circulation and venous sinuses bled profusely. Attempts to place artery clamps unsuccessful as tissue was so hard. Flap dissected down about one quarter of distance when patient's pulse jumped to 180 and grew very weak. Operation stopped and wound closed drawing edges together in upper angle but closing the parallel incisions as such in the lower three fourths of leg. Rubber tissue drain in upper angle of wound. Six hundred cubic centimeters of normal salt solution given intravenously. Patient left operating room with good color with fast weak pulse. This boy was last seen on March 1 1928. At that time the elephantiasis was practically the same but he had had no recurrence of the attacks of lymphangitis.

Sistrunk calls attention to the incidence of shock in these operations but he places hemorrhage in the second place in its causation and extensive injury to sensory nerves in the first place. The shock in this last case seemed to be due primarily to the hemorrhage.

CASE 1 No 12298 M B Gurabo female 35 years old was admitted September 26 1922. She had advanced elephantiasis of the right leg for 16 years with no history of lymphangitis. On October 4 1922 after the patient had rested in bed for 8 days a Kondoleon operation was performed on the outer side of the leg and on October 19 on the inner side. The immediate result was primary union and the patient was discharged on October 31 in an improved condition. She was examined April 8 1923 (5 years later) at 5:00 p.m. after doing laundry all day. Before operation she had never had any attack of fever but at that time she was having one every 3 or 4 months. The leg was becoming larger with each attack although she had not noticed any redness of the leg during the attacks. She had never worn a rubber stocking because of the expense. Measurements showed the leg to be about the same size as before operation.

C s N 4 J C C bo m le 35 11  
dm tt d N mf ro Heh d typ al pl n  
t f th l ft l g t d g f m the k t h f t  
Att k f l y m f g t u d b t y 6 m t l  
O D mb 5 ft th p t t l d t e l b l f 9  
d v K d l p t n m l t l k e e t  
f th l t l t l g f m l t l k e e t  
j t b l t l k l The m m d t l t p m a y  
T l j t t l f l g l d m l 5 th  
t l g m p e d H e m l g m l 5 p l 9  
9 (5) t t t t 4 3 p m f l g h l d  
l t d (b l ) l l d l l d l g h l d  
t h l t t t t k f l y m l g t l d  
l l f g t H l l t t k g n  
l l M m t l t l f l g t l f h t l  
l g th t l t l l t l g t l f h t l  
C 3 N 4 M l A k d l l f m l y  
l d t t t t l t l t l d d d  
l p h t t l t l t l b l l d d n t t k  
f l m p l t f 6 O t t f t t p  
t t h d t l f l f l k l l p t  
t d f m l t h t l f l t l k t h m m l  
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p t d t t l t t l t t d f t t U t j  
St t t t t l t l p t v t  
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l d l d b t l k f t t k f l y m f 5 t  
C 4 N C C A k l l l 4 d m k l f  
l g h t t t l t l k f k t t  
t k f l m l t h l d f O M t  
3 ft l t t t d t l f l f l k  
l l p t t t t l f t h l t  
leg th t l g f t l t k t l t  
Th p t p t l d t l t l k  
M b 9 l l m m t t l t l  
t h p t l h g d V l m f l t  
l t H m m l h N (3) l t  
t 8 p m f t h k l l l r m l l  
d y H l t l t t l k l t t t k f  
f e h d l k t l l t l t h n  
l b g t l t l f l m p h g t  
H h t l t k g d l l k a t t t h e  
C s 5 N C C A d l l f m l 3 y  
of g t t l t l M l S l l d l  
l p h t t l t l t l t t l t k f  
l m p l g t O M h t t t t l a f e t l  
l f d K d l t t t f d  
t h u t d f l t l t t t g f m the  
m d t h t t l k l f l t p t l  
t h l t l t l V l l l m d t e  
l t f m l l t t t w a d l a g e d  
A p l 8 m y l l t S l e w m l  
M h 3 S y l t t t 3 p m f t h a g  
k d l l l f t l d r S t d t h t  
h h d h l t t k f l y p h g t Sh h d t  
h d b l t k l f t t a l t h u g l  
h d d l k l l l A b t y f t r h e p  
t t l f t h l t l t l t d l o f d h g h t  
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C 6 N 4 S l P P d a f m a l 4 y  
old dm tt l t t o Sh h d m k d l  
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l y m p g t f o y O S p t m e o f t t h e  
p t t h d t t d f o d y K d l p e  
t n d t h t s d f t h g l t l g t h e i

TABLE I MEASUREMENTS BEFORE AND AFTER OPERATION

C	C m f b f			I f m			C m f t			C m f f l d		
	A k l	C l k	K	A k l	C l k	K	A k l	C l k	K	A k l	C l k	K
		7 5	6	5	y			8 5	5			
				5	y			7	4 5		7	
		6 3	5 5	3 3				6	5			
5			5	3			8 5	6	4	7 2	4	5
6	5		5	y			8 5	5	5			
		5		3				4		9	5	5
8				6 3		7		5	9 7	3 5	5	5
	6	7	m					5				

M f l a b o l m t t t m f m

e t d g f o m a l o t h k t o t h k l The  
m m d t e l t p m y o a d t h p t t w  
d l g e d O t l 3 i m p d d t She  
n l A p l o r o 7 ( y e s l a t ) t 4 3 p m  
Sh l t t h h d l d n t t a c k s f l y m p n g t u  
e t l o p t n She h d w o n a r u b b t k g  
t u l y e d c h a g Sh w e i g d p o d s  
l g g i e d p o d T l g h t h d t c e d  
C 7 N 6 4 I I A g d l l a m l 4 y e s  
l l a l m t d S p t m l 9 9 5 H h d l p h a n t  
o f l t h l g m m k e d t h f t F o 8 m t h s h  
l d h d r u t t t c k s f f e b o t o l y m p t s o f  
t l l O n O t b 13 f t e r t h p t n t h d t e d  
b d f 15 l y K n d o l e o p e t w a d o n t h e  
t e d o f t h e f l e g t l c n e t d g f m a b e  
t h k e t o t a k l O N o m b e 4 s m l p e r a t o n  
p f m d t h e d o f t h e l g The m m e d t  
l t p m y o a d t h p t e t v a d c h a g e d  
N m b a m p d o n d t H w e  
m i A p l 6 9 7 ( y l a t e r ) t 3 p m a f t e  
h h d k e d l f t l l d y H e h d b e f e f o m  
t t k f f e p u t l t h p t m o n t l w l e h h d  
t k l t g f d v H h d n e o a r u b b r  
t k b e c e f t h p e B o t h l g h d c t u n e d  
t e l l  
C s e 8 N o 9 6 I V F a j d m a l e 3 y a s o l d  
d m i t t e d N m l 6 9 9 H h d f d c d  
e l p l a n t a s i s f t h g l t l g a d h d h a d e t t  
t a k f l y m p l g t O N o e m b a f t t h p t n t  
l d r d t b d f 5 d a y a K d o l e o p r a t w  
d o t l e i d o f t h l t l e g t h i s e  
t d f r o m j t b l w t h e g t t h e i t l m l e o l u s  
T h o p e a t u w r e p e a t e d n t h u t r d f t h e l g  
o J a k y 3 9 t h e i t t d g f m t h l  
f t h e k e j t t h e e t l m a l l e o l s A t h d o p r  
t w d t h p t e p t f t h e l g F b r u a 9  
t h i n o t d g f m t h k t o t h n a l The  
w o d h l d l o w l y d t h p t t w d h g e d o  
M h 6 c d r a b l y m p d H e e m u e d m y  
l l M a y 5 9 7 ( 6 y a s i t ) d f d t o b  
g t l y m p d B f o o p t h h d b h n g 4  
5 t t a c k s f l y m p g t y a b t f r y f l o w

ing operation he had had no such attacks. Then for a period of a year he had 3 or 4 attacks and for the last 2 years had been free from attacks. He said that during the day while he worked as an oiler in a cigar factory his leg swelled but that the swelling went down at night. He had worn a rubber stocking continuously and for the last leg although somewhat larger than when I first treated him. The foot was still about half the size that it was before operation.

CASE 9. No 18609. M. C. Aguahilla female 43 years of age was admitted October 18, 1927. She had had elephantiasis of the left leg for 12 years but had had no fever or lymphangitis. On October 5, after the patient had rested in bed for 6 days, a Kondoleon operation was done on the outer side of the left leg. The patient tended to from above the knee to the ankle. This operation was repeated on the inner side of the leg on November 10. The incisions extending from the mid thigh to the ankle. Some shock followed the second operation and the patient had the intravenous administration of 300 cubic centimeters of normal salt solution. The wound healed by primary union and the patient was discharged on November 18 in an improved condition. On April 18, 1928, 6 months later she wrote that she had been wearing a rubber stocking and that the swelling of the leg was greatly relieved and the result satisfactory.

A brief of these 11 cases is as follows: 1. Kondoleon operation with immediate amputation. 2. Kondoleon operation—there was marked involvement of the foot which was no better at the time the patient was discharged from the hospital. 3. 1 attempted Kondoleon not finished because of hemorrhage. 4. Kondoleon—the condition is worse now (5 years after operation) than before operation. 5. 2 Kondoleon operations—the condition is now (1½ and 3 years after operation) the same as before operation. 6. Kondoleon—the condition is somewhat improved. 7. The patient does not wear a rubber stocking. 8. Kondoleons—the condition is markedly improved. All of the patients wear rubber stockings.

#### SUMMARY

1. The operative risk for the limb is greater when both sides of the legs are operated upon at the same time. The greater safety to the patient would seem to justify the two stage operation.

2. Cases in which the foot as well as the leg is involved give poor results even when the incision is made down to the toes.

3. If the subcutaneous tissue is extremely hard very troublesome hemorrhage may develop and materially increase the danger of shock.

4. The periods between attacks of lymphangitis are lengthened in the majority of the cases. In one of our cases the attacks disappeared altogether for a period of 3 years while one patient developed attacks of lymphangitis after operation.

5. Social status plays an important part in the end results. Patients who work on their feet many hours a day have poorer end results than do those who are not compelled to do hard manual labor.

6. A rubber stocking worn during the day is a great aid if not an essential feature in combating the return of swelling following operation for elephantiasis.

7. Results in Porto Rico for the Kondoleon operation for the cure of elephantiasis have been discouraging.

#### BIBLIOGRAPHY

- HANLEY W. S. Lymphangioplasty, a new method for relief of the brachy arm of breast cancer. Report for similar condition of lymphatic edema. *Int J Surg* 1905 8:4.
- HALL A. L. Report on the cure for elephantiasis. *Lancet* 1905 31:33.
- HUNT H. H. Hunterian lecture on the surgery of the lymphatic system. *Brit M J* 1910 1:863, 92.
- HILL I. L. Elephantiasis treated by the Kondoleon operation. *Sur Gynec & Obst* 1927 19:244.
- HILL I. L. Elephantiasis. *Sur Gynec & Obst* 1927 19:334, 335.
- KÄSTNER F. Die chirurgische Behandlung der Elephantiasis ben Oedem durch eine neue Methode der Lymphablenkung. *Muenchen med Wchnschr* 1907 11:7-27, 9.
- LEIDY D. Operatione Behandlung der elephantiasis. *Monatsschr f Chir* 1911 38:1022-1025.
- LINZ O. J. roeffnung neuer Abfuhrwege bei Stauung in Bauch und unteren Extremitäten. *Zentralbl f Chir* 1911 38:153.
- LEMOINE M. Méthode pour tablier circulaire lymphatique collatérale par le traitement de l'œdème par injection de l'elephantiasis. *Bull et mem Soc de l'Elephantiasis* 1911 33:1340.
- MATTHEI I. The surgical treatment of elephantiasis and elephantiasis states dependent upon chronic obstruction of the lymphatic and venous channels. *J Trop Dis & Prent M* 1913 July.
- OPPEL V. A. Conservative operation treatment of elephantiasis. *Klin Wchnschr* 1911 38:397-399.
- ROBINSON W. M. Lymphangioplasty. *Klin Wchnschr* 1912 39:645, 655.
- ROBINSON H. A. Elephantiasis and Kondoleon operation. *J Am M A* 1914 11:1720-1722.
- SILVERMAN E. L. Elephantiasis treated by Kondoleon operation. *Sur Gynec & Obst* 1927 19:389-393.
- Idem. Kondoleon operation for elephantiasis. *J Am M A* 1928 11:800.
- Idem. The Kondoleon operation for elephantiasis. Report of end results. *Southern M J* 1927 20:69, 65.
- Idem. The results of treated in elephantiasis through the Kondoleon operation. *Minnesota Med J* 1923 11:173, 17.

## TRACHEOTOMY TECHNIQUE AND AFTER-CARE OF THE PATIENT

By WILLIAM H. JOLEAU, M.D., CLEVELAND, O.  
CLINICAL

THE rare indications for tracheotomy have been described in a recent paper.<sup>1</sup> Once decided upon, there should be no delay. The patient should be kept unaware of the plan until all preparations have been made, and he should then be told simply that his difficulty in breathing will be relieved by a minor procedure. It is much better for the patient and just as easy for the surgeon to have the operation performed in the patient's room.

The patient requiring tracheotomy is often in a critical condition and must be given every consideration. A congenial anæsthetist should be present to talk with the patient and to cover the eyes with cold compresses. An inhalation anæsthetic, even though it were desirable, is out of the question on account of the laryngeal obstruction. If time permits, the operative field should be infiltrated thoroughly with a  $\frac{3}{4}$  per cent solution of novocain, but in an emergency this may be dispensed with. The patient should be inclined at an angle of 45 degrees. The neck should be straight or slightly extended. To extend the neck fully may cause a complete laryngeal obstruction and thus necessitate great haste in performing the operation.

If the patient has recently had a thyroidectomy or other operation in the region of the trachea, the skin edges should be separated for a distance of from 4 to 6 centimeters in the middle of the neck, and the lower sutures should be removed from the fascia and the ribbon muscles, thus exposing the trachea. If the patient has not had such an operation, a transverse skin incision from 4 to 6 centimeters in length should be made in the middle of the neck, on a line 2 or 3 centimeters above the sternoclavicular junction. The skin edges should be dissected free from the fascia both upward and downward, a longitudinal incision made in the fascia, and the ribbon muscles separated in the midline. If it is not possible to expose the trachea well below the isthmus of the thyroid gland, then the isthmus must be resected. If time permit, complete hæmostasis should be obtained by means of fine plain catgut; otherwise gauze packing should be employed. Once the trachea is exposed, the neck may be safely extended.

The most favorable site for a tracheotomy is between the fourth and fifth, or between the third and fourth tracheal rings. A low tracheotomy is more comfortable and heals more quickly, while a high tracheotomy may cause permanent injury to the larynx. A transverse incision between 1 and 2 centimeters long should be made between the two rings, the edges of which should be held apart with a small forceps while the tracheotomy tube is gently and deliberately inserted. The obturator should be removed at once. At times it is well to let the patient take several breaths through the opening before the tube is inserted. Before the trachea is incised, the patient should be told that he will breathe through a lower opening and will be unable to talk for the time being. At this stage the patient should cough out through the tube any accumulation of mucus or blood that may be present. A suction machine is often of great assistance. When the patient has grown quiet and it is seen that there is no bleeding, a small strip of gauze should be loosely packed around the tube at its entrance into the trachea, and the inner tube inserted. The muscles and fascia above the opening should be approximated in the midline with interrupted sutures of catgut, and the skin edges should be approximated, leaving just enough room for the tube and the pack. The dressing is made by cutting a slit half its breadth in the center of a rectangular piece of gauze and applying it so that the edges of the slit fit under the flanges of the tube, thus leaving the opening uncovered.

Following a tracheotomy, except for the first few deep breaths, the patient generally breathes quietly. However, if considerable morphin has been given, not uncommonly he ceases to breathe and becomes cyanotic. In such a case artificial respiration is almost invariably effectual.

The operating tray should be removed before the patient's eyes are uncovered. The surgeon should then reassure the patient and explain that the tracheotomy was done to relieve a temporary obstruction in the larynx analogous to that caused by diphtheria in children. The patient may be further reassured by placing a finger over the opening in the tube on exhalation, thus enabling him to cough and talk. After he has been thus reassured, the patient usually sleeps quietly for several hours.

In no other type of case is the patient so dependent upon the constant and expert attention of the house staff and nurses as after tracheotomy. In addition to the fact that a patient who has to have a tracheotomy is in a poor physical condition he is generally apprehensive. He is very quick to learn the expert touch and without it loses ground rapidly. As a rule he should never be left alone for the first 48 hours or often for a longer period. The temperature of the room should be moderate. Tents over the head of the bed are unnecessary and only give a sinister appearance to the scene. A pitcher of steaming menthol solution at the side of the bed often gives comfort but hot inhalations seem to increase mucus formation and thus are undesirable. The patient is generally most comfortable on his back in a semierect position but he should be turned from side to side at intervals. It is well to insist upon his taking several deep breaths every hour while he is awake as this may tend to prevent the development of a pulmonary atelectasis which is a complication that must be guarded against in this type of case.

A piece of gauze should always be kept on the patient's chest so that when mucus is expelled it can immediately be wiped off the end of the tube and will not be inhaled. The inner tube should be removed as often as is necessary to keep it clean and this can be done without disturbing the patient. If this is neglected the tube will soon become obstructed with tenacious mucus or blood.

Some patients have very little mucus while others almost drown in it. Some are able to expectorate through the tube while others are unable to raise it as high as this. In the latter type of case an aspirating machine is absolutely necessary. This machine should have a strong but silent electric motor to which is attached a soft rubber catheter preferably with a whistle tip. If the tracheotomy tube is size No. 4 or smaller it is well to remove the inner tube before the catheter is inserted. The catheter should be large enough to permit mucus to pass through it fairly easily, however not so large as to prevent the patient's breathing around it when it is in the tube. It is generally sufficient to insert the catheter as far as the lower end of the tracheotomy tube since the patient can readily raise the mucus as high as this. Only rarely in case the patient is very weak is it necessary to insert the catheter as far as the bifurcation of the trachea. This should not be done too often as it irritates the trachea and provokes an exhausting spell of coughing. It is well to aspirate the larynx occasionally through the

mouth. Water should be aspirated through the catheter at frequent intervals to keep it clean. Care should be taken not to allow the receiving jar of the machine to become too full as fluid will be sucked into the pumps and this will put them out of commission.

An extra tracheotomy tube should always be at hand. The gauze packing should be changed every 8 hours or oftener depending upon the amount of oozing from the wound. Mild antiseptics may be used but strong ones are contraindicated as they may seep into the trachea and cause irritation. A tracheotomy wound must always be considered as infected however if it is kept clean the infection is of little significance. On the other hand if it is neglected a very troublesome putrid infection is apt to develop. Such an infection is very difficult to treat both on account of the opening in the trachea and the irritability which prevents much manipulation. A considerable amount of necrotic tissue develops which must be carefully cut away. Chief reliance must be placed on the mechanical cleansing of the wound with dihalamine T if used with care being very satisfactory.

The degree of the laryngeal obstruction can be determined quite accurately by occluding the opening of the tube or better by removing the tube and occluding the opening in the trachea and further information can be obtained by a visual examination of the vocal cords. If possible the tube should be removed within 3 hours however if there is any question it is better to leave it in longer. If removed early the opening can be closed with a single fine chromic catgut suture in the overlying tracheal fascia and in this case the remainder of the wound may be closed except for a drain down to the trachea but if the tube has been in for more than 12 hours the suture will be of no avail. In such a case the opening should be occluded with gauze packing of sufficient size so that it can not be drawn into the trachea on inspiration. This should be changed every 1 to 3 hours as it soon becomes saturated. The wound should be kept scrupulously clean. Granulation tissue grows rapidly and in from 10 to 12 days the wound will be completely healed. Factors which influence healing are the height of the opening, the degree of infection and the length of time the tube is in place. In some cases even after the tube has been removed the opening will remain and the patient is dependent upon it for part or all of his air supply. This is the most difficult type of wound to keep clean.

Generally the scar is very little larger than it would have been if the wound had healed per

*primam* However if it is unsightly and trouble some a plastic operation may be performed but it is better not to attempt any plastic work until a year has elapsed The scar may then be excised and the muscles freed and approximated in the midline over the trachea The result is very satisfactory

If tracheotomy is performed in a case of severe hyperthyroidism the patient requires a great deal of water and nourishment Not infrequently in such a case there is an associated pharyngeal paresis which causes choking upon any attempt to swallow It is unwise to urge the patient to swallow as the choking is very exhausting and the aspiration of fluid into the lungs may cause pneumonia Some patients are able to swallow thick liquids fairly well while others choke on anything it is the latter type which presents a serious problem—how to give sufficient fluid and nourishment without unduly disturbing the patient Water can be given by hypodermoclysis but this becomes painful if kept up for several days while the amount of nourishment that may be given by intravenous methods is greatly limited by the poor condition of the heart and also by the danger of a chill if it is given in any amount or very often Proctoclysis is not usually ineffectual in this type of case Gastronomy could be satisfactory but it is too radical a procedure

The method of choice is to insert a soft rubber tube size 10-14 F into the stomach through the mouth or preferably but with more difficulty through the nose This generally has to be done

under direct vision as the tendency is for the tube to enter the larynx This tube should be left in until the patient can swallow around it Care should be taken not to insert it much beyond the cardia as otherwise the end will become kinked and obstructed The tube is less apt to be annoying than hypodermoclysis or an intravenous injection and in the few cases in which it has been necessary we have not seen one in which it could not be used to great advantage All fluids and nourishment and most medicines can be given through the tube though care should be taken not to overload the stomach as in this type of case the patient is frequently nauseated Fluid can be injected into the tube every hour even while the patient is sleeping The tube can generally be removed in 3 or 4 days If a patient who has had a tracheotomy performed is going steadily downhill he often improves rapidly once the tube has been inserted and he receives sufficient nourishment

As soon as the condition of the heart permits the patient should be allowed to be out of bed as this has a very beneficial effect upon the psychic state He no longer considers himself dangerously ill A man should be shaved and a woman allowed to use the cosmetics to which she is accustomed Patients should also be allowed to substitute their own clothes for the regulation hospital garb In encouraging surroundings and with good care these patients get along remarkably well Only rarely does a patient die from a complication following tracheotomy

SOME HISTORICAL NOTES ON THE TECHNIQUE OF CÆSAREAN SECTION<sup>1</sup>

BY LOUIS I. PHANEUF, M.D., F.A.C.S., BOSTON

P l e s f G y e e l g y T f t C l l g M d l s h l C h f f s

D p t m t f G y l g y d O b t t C y l l p l l

CÆSAREAN section is the removal of the child through an incision made in the abdominal wall and uterus. The term is not applied to the extraction of the child from the abdominal cavity after the uterus has ruptured nor to ectopic gestation.

The term *cæsarean* section is probably derived from the Latin *partus cæsareus* from *cadere* to cut. A better term however is abdominal hysterotomy but despite this the term *cæsarean* section is used throughout obstetrical literature. There is no reliable evidence that Julius Cæsar was delivered through his mother's abdomen. Furthermore *cæsarean* section on dead women was performed long before Cæsar's time. It is noteworthy that at this period the operation was never performed on living women and Cæsar's letters to his mother during his wars prove that she was alive.

The operation on the dead woman is referred to in the myths and folklore of European races and was probably performed by the early Egyptians. It is stated that Dionysus was cut from the dead Semele. The *Lex Regia* of Numa Pompilius 715 B.C. expressly orders the removal of the child before burying the mother. The ancient Jews gave the name of Jotze Dofan to children delivered through the abdomen of the mother. In the year 1879 Felkin saw a native in the heart of Uganda perform a *cæsarean* section and his description of the operation is interesting in the light of the crude attempts at anaesthesia and antiseptics. Banana wine served the purpose of both the patient being drunk with it (bibation anaesthesia) and the operator washed his hands and the field of operation with it to sterilize them. He opened the abdomen and uterus by a quick incision the cord was cut the placenta removed the cervix dilated from above and the uterus massaged until contracted. The peritoneal toilet was accomplished by lifting the patient. The operation was completed by closing the abdomen with pin and figure of eight sutures and the wound was dressed with a paste of crushed herbs. It is stated that the temperature remained below 101 degrees F. and that the wound was healed in 11 days.

Looking further into the history we find the first generally accepted *cæsarean* section was per-

formed in 1610 by J. Trautmann of Wittenberg on a woman with hernia of the gravid uterus. Somewhat earlier J. Nufer of Switzerland a swinegelder by occupation is said to have delivered successfully his own wife by this method when several midwives and barbers had given her up. The mortality in these early days was frightful and the operation was done only on women who were already doomed. Rousset's monograph played no small part in bringing to the attention of the profession this procedure which was so bitterly opposed by Europe's best known accoucheurs. The operation of symphysiotomy devised by Sigault was at that date the greatest competitor of *cæsarean* section.

In reviewing the statistics Kayser of Copenhagen in 1844 found a mortality of 62 per cent for the previous 30 years. Larnier is said to have made the statement that in Paris up to his time no woman had survived the operation during the nineteenth century. Sprath recalled a similar experience for Vienna in 1877. In the United States Harris collected 80 cases and these showed a mortality of 52 per cent the fatal cases resulting from hemorrhage and infection. Although Lebas in 1769 had put 3 stitches in the uterus and left the ends long so that they could be removed it was not until 1881 that Saenger described his method of suturing the uterus. In 1877 Porro of Pavia had recommended the supravaginal amputation of the uterus after delivery in order to overcome the two serious complications namely hemorrhage and sepsis. This radical method so improved the results that it was instrumental in preventing the conservative *cæsarean* section from developing into the comparatively safe operation which it has become. Saenger's technique was responsible for determining the indications for the more radical method namely an operative procedure to be used only in the presence of a definite indication for sacrificing the uterus.

FIRST CONSIDERATION OF CÆSAREAN SECTION  
THE LIVING CHILD

The first consideration of *cæsarean* section was the living baby. With this in mind the early operators insisted upon speed for they felt that the sooner the child was born the better were its



chances of living Those were the days of spectacular operating when not infrequently the abdomen and uterus were opened with one sweep of the knife Unfortunately accidents resulted such as cutting a loop of intestine which might inadvertently have floated in front of the uterus Again babies were injured by the too deep penetration of the knife in the uterine wall

These accidents as well as other factors have shown that time is not the only element which enters into a successful operation Reflection on the duration of general anesthesia in an ordinary forceps delivery might have suggested that undue emphasis was laid on the need of shortening the time of anesthesia Other factors affecting the child's welfare are the administration of morphia too soon before starting the operation and the resulting intra uterine asphyxia trauma to the child by attempting delivery through an insufficiently long incision and disturbance in the child's nutrition in the presence of a prematurely separated placenta and placenta prævia Prolonged anesthesia as a result of the too slow extraction of the child is rarely a factor in the hands of experienced operators

#### SECOND CONSIDERATION OF CÆSAREAN SECTION THE WELFARE OF THE MOTHER

Finally the welfare of the mother has given more consideration when it was discovered that a living baby could be obtained easily and that with the early technique the results to the mother were generally serious and often disastrous

To what dangers or disabilities is the mother exposed when the child is delivered abdominally? These may be classified as either immediate or late dangers

*A Immediate danger 1 Hemorrhage* While in the early days of cæsarean section hemorrhage was one of the greatest dangers this has now been so minimized by proper methods of suture and by the use of pituitary extract and ergot that it is but rarely a troublesome factor The injection of adrenalin in the uterine muscle is also of marked value in causing a flabby uterus to contract Again an incision in the thin lower segment rather than in the thick body of the uterus greatly lessens the amount of bleeding Another factor responsible for blood loss is the relaxation of the uterus under ether narcosis as compared with local infiltration and spinal anesthesia Brindeau at the Tarnier clinic has demonstrated to his own satisfaction and to that of others that spinal anesthesia causes contraction of the fundus and relaxation of the lower segment It is a proved fact that the operation under

regional or spinal anesthesia is much less hemorrhagic than when performed under general narcosis The relaxation of the uterus for hemorrhage during the course of cæsarean section is so rare nowadays that it is hardly worth mentioning

*2 Trauma of operation* Shock following cæsarean section has been greatly decreased by the conservation of blood and by the improved technique and consequently gentle handling of the abdominal contents It is not a very common complication nowadays and as we see it it is usually associated with hemorrhage and undue loss of time in operation Shock is observed in a larger percentage of gravid cardiac patients than in any other group of patients

*3 Sepsis* Infection has always been an important if not the most important cause of mortality and morbidity in cæsarean section and at the present time stands out as the most serious complication The time at which the operation is performed is the most important single factor in dealing with infection This is especially true in the light of the work of Harris and Brown who have demonstrated at cæsarean section the bacterial invasion of the uterus early in labor even with unruptured membranes The classical operation performed before labor or at the onset of labor is relatively safe as compared with the same procedure performed in advanced labor Vaginal examinations and the rupture of the membranes also increase the danger of sepsis to a marked degree Infection has been decreased by the use of the lower segment operations which will be taken up later in this paper

*B Late dangers or disabilities 1 In alidism* As a result of a major operation a number of women may have poor health for a more or less prolonged period of time

*2 Sterility* The incapacity to bear other children in a small group of cases is especially apt to follow uterine infection and suppurative with resulting destruction of the endometrium

*3 Rupture of the uterus* The danger of rupture of the uterus during pregnancy is a real one and has to be taken into consideration The danger of a subsequent labor and the immediate danger of a ruptured uterus at delivery are not to be looked upon lightly The low operations have strikingly decreased the danger of rupture of the uterus during pregnancy and labor and have thereby added to the safety of abdominal delivery

In varying degree these 6 chief factors have been of influence in the development of the technique of cæsarean section

## THE INCISION IN CÆSAREAN SECTION

In the early days of cæsarean section the abdomen was opened at the most prominent part obviously over the uterus. The incision was started near the symphysis and carried to a point near the xiphoid cartilage to the right or to the left of the umbilicus. The uterus was delivered and incised quickly in the median line in the corpus. There was a vast amount of handling of uterus and intestines, large gauze packs, even towels were used for packing and there was as we should expect now, considerable harm done to the mother. The child was usually delivered by the breech, the placenta and membranes were extracted manually through the uterine incision and suture of the uterine incision was accomplished in layers, one to four layers being advocated by different operators. The suture materials advised were silver wire, bronze wire, silk, linen, silk, worm gut and catgut. In this type of operation there was considerable handling of the abdominal contents and therefore considerable shock. Moreover the uterus frequently became adherent to the long scar in the abdominal wall and consequently caused fixation and distortion of the organ. To overcome these objections a smaller abdominal incision was made to the right of the umbilicus, the latter being used as a midpoint, the uterus was incised *in situ* and the intestines were protected with gauze or towels. Here again there was considerable handling of intestines but the adhesions proved less frequent. This is the most common incision used today in performing the classical section and the one which is described in most textbooks on obstetrics.

Hæmorrhage from this type of operation was rarely found to be very troublesome, shock was frequently a factor as there was so much handling of intestines although this shock decreased with the size of the abdominal incision. It became much less when eversion of the uterus was abandoned. Infection in the classical type of operation has always been a serious factor as the uterine incision is in no way isolated from the general peritoneal cavity. Infection could come from the introduction of septic material from above but this in a large measure has been overcome by a proper skin preparation and the protection of the edges of the abdominal wound by means of sterile towels or rubber dam. The infection from below cannot so easily be prevented and as it has been proved that bacteria invade the puerperal uterus during labor or early in the puerperium, these bacteria readily find their way to the peritoneal cavity between the stitches or through the stitch holes. The incision in the

uterine body has thick edges which bleed readily. The sutures used to close this incision must serve two purposes, hæmostasis and coaptation. There is always present the danger of tying the sutures so tightly in order to insure hæmostasis that pressure necrosis and infection of the injured uterine muscle will result. Again the contraction and relaxation of the uterine fundus during the puerperium may cause the edges of the uterine wound to be ground against each other and disturb the sutures, thus interfering with proper healing. In the classical type of operation injury to the peritoneum, handling and exposure to air, lower the resistance of the tissues and favor infection.

The high longitudinal incision next came into vogue. It was devised to prevent adhesions between the uterine wound and the abdominal wall. In this procedure the abdominal incision is made directly above the umbilicus, the abdominal contents are walled off with gauze, the fundus of the uterus is incised longitudinally and delivery accomplished. At the completion of the uterine suture, which is made in two layers with chromic catgut, the uterus sinks below the umbilicus so that the uterine and abdominal incisions are never in contact and adhesions between the two are prevented. Intestinal and omental adhesions to the uterine scar are not prevented by this technique and as a matter of fact have been common in my experience. Furthermore with the high incision a not inconsiderable amount of liquor amni and blood trickle down to the pelvis where they may not be easily reached, thus making the peritoneal toilet difficult. I have seen more intestinal distention and paralytic ileus following this method than with any of the other accepted techniques of performing the classical cæsarean section.

The high transverse fundal incision was brought out on the grounds of a better uterine scar, diminished danger of infection and in an attempt to prevent adhesions between the uterine and abdominal incisions. It was thought at that time that the further the incision was placed away from the cervix the greater would be the chance of preventing sepsis. This method never attained much vogue. The disadvantages are those of the high operation with the longitudinal incision and no advantages over the latter are offered.

In order to overcome some of the difficulties of the high operation, Newell advocated a lower incision in performing the classical cæsarean section. His incision in the abdomen is made in the middle line entirely below the umbilicus and because of this intestinal handling and soil

ing are almost entirely eliminated and intestinal distention is thereby greatly diminished. The uterus is left *in situ* and a longitudinal incision is made in the lower portion of the corpus.

Munn & Kerr of Glasgow, in order to obtain a better scar and to attempt to diminish rupture of the uterus in subsequent pregnancies and labor has devised an operation which he terms an *intra-segmental cesarean section* and which fills an intermediate place between the classical and cervical cesarean sections. He makes a transverse incision at the isthmus or where the lower segment joins the body of the uterus. As he does not separate the bladder he does not really get below in the inferior segment. His published results in over 100 cases were excellent.

#### CERVICAL CESAREAN SECTION

After hemorrhage had been controlled and the complications diminished in a properly performed cesarean section the attention of those interested in the problem was directed toward infection and the prevention of peritonitis. This resulted in the evolution of the cervical cesarean section which went through three stages: first the extraperitoneal cesarean section, second the transperitoneal cesarean section with suturing of the peritoneum to the abdominal wall, and third the retrovesical or subperitoneal cesarean section.

1. *The extraperitoneal cesarean section*. The operations of Kuestner and Latzko best represent this type and were devised in order to accomplish delivery through the lower uterine segment without entering the peritoneal cavity. Through a median or lateral longitudinal pelvic incision the unopened peritoneal sac is lifted off the anterior portion of the outlet, the bladder and the lower uterine segment. The cervix is thus cleared, a longitudinal incision is made and delivery is accomplished. The true extraperitoneal cesarean section probably offers the best means of protecting the peritoneal cavity although it has been demonstrated that a virulent streptococcus may find its way through the intact peritoneum and cause septic peritonitis. The disadvantages of this method are first that not infrequently the bladder and the ureter on the side where the operation is performed are injured and fistulae are produced; second the peritoneum is occasionally opened during its separation and the advantage of the extraperitoneal method is lost; third the site of operation has to be drained and this results in suppuration and long drainage in many instances; fourth there is more hemorrhage since the incision in the lower segment has to be made to the side nearer the large vessels

rather than in the middle line and the technical difficulties are greater and last the operation cannot be repeated because of adhesions.

2. *The transperitoneal cesarean section*. This method known as the *Veit Fromme Hirst* operation was next devised with the idea of protecting the peritoneal cavity and at the same time overcoming the disadvantages of the extraperitoneal method. This operation is performed through a longitudinal pelvic incision; the vesico-uterine peritoneum is incised longitudinally, the bladder is separated from the cervix and two lateral flaps of visceral peritoneum are dissected. These are united to the parietal peritoneum thus creating a so-called extraperitoneal space through which a longitudinal cervical incision is made and delivery effected. The peritoneal flaps are at first united by carefully applied interrupted catgut sutures and after the closure of the cervical incision they are further approximated by a continuous catgut suture. The peritoneal edges are firmly united in the course of a few hours and thus the cervical incision is entirely extraperitoneal during the convalescence. This method also protects the abdominal cavity during delivery. The disadvantages are that occasionally the peritoneum is very thin and does not separate well from the uterus and that it leaves a band of scar tissue extending from the cervix to the abdominal wound thus fixing the cervix at a higher point than normal in the pelvis.

3a. *The intraperitoneal retrovesical or subperitoneal operation*. Kroenig threw new light on the subject of cervical cesarean section when he claimed that the better results obtained by the method were not due to the fact that the uterus was approached in an extraperitoneal manner but because the incision was made in the thin non-contractile lower segment rather than in the thick contractile body of the uterus and because the uterine incision was completely covered over by the bladder thus protecting the peritoneal cavity should infection occur during the puerperium. The operation consists of opening the abdominal cavity by a low longitudinal incision separating the bladder from the uterus making a longitudinal cervical incision and after the extraction of the child placenta and membranes closing the uterine incision and completely covering it by suturing the edge of the bladder peritoneum to its original position on the uterus or slightly higher.

3b. *The transverse cervical incision*. Experience has shown that the intraperitoneal retrovesical operation offered definite protection against peritonitis and could be performed safely on

women advanced in labor and in cases in which the classical cæsarean was definitely contraindicated. The published statistics show that the incidence of ruptured scars was also greatly lowered thus removing from cæsarean section one of its real dangers. In the study of the statistics it was discovered that the few weak scars encountered were due to the fact that the longitudinal cervical incision had been unduly prolonged upwards thus encroaching on the uterine body. It was found that the portion of the incision placed in the cervix healed solidly while that extended in the musculature might show thinning and weakness at this point. The transverse cervical incision was the next step in the evolution of the operation and permits placing the scar entirely in the lower segment without in any way encroaching upon the musculature. It seems reasonable to feel that this procedure should further reduce the already low percentage of weak scars. The operation is performed through a longitudinal pelvic incision the bladder is separated from the cervix down to the vagina and as far as possible laterally and a transverse cervical incision is made low down and is curved upward at the sides to give more room. At the completion of the uterine suture the bladder is reattached at its original level thus making the incision entirely retrovesical or subperitoneal. A good idea of the scar in its entire extent may be had on palpating the anterior lip of the cervix after involution has taken place and is felt as a thin ridge under the bladder in some cases and not at all in others.

*Torzo cæsarean section or cæsarean section followed by hysterectomy.* The technique of this operation as performed nowadays differs from the original inasmuch as the stump cervical or vaginal depending upon the extent of the hysterectomy is dropped into the abdominal cavity and completely peritonealized. With the advent of the cervical cæsarean section the indications for this radical procedure have been greatly lessened. Five indications are prominent: (1) mismanaged labor and frank infection (2) uterine apoplexy (3) uterine myomata (4) uncontrollable hæmorrhage and (5) carcinoma of the cervix.

*Cæsarean section with temporary exteriorization of the uterus.* This method devised by Portes of the Baudelocque Clinic in 1923 is intended for mismanaged cases with frank infection and has again reduced the indications of hysterectomy in a definite group of these cases. As the name implies the sutured uterus is left on the abdomen after the delivery of the child until involution has taken place and the uterine sensus has subsided.

Then it is returned to the pelvic cavity. The field of applicability for this operation is necessarily very limited but it saves maternal and fetal lives and permits the conservation of the uterus an important factor in young women. The mortality following this operation has been exceedingly low.

*Vaginal cæsarean section.* In 1895 Duehrsser described an operation under the name of anterior vaginal hysterotomy and in 1896 called vaginal cæsarean section. The original operation only called for a median anterior incision through the cervix but later the technique was modified by adding the posterior incision. Thus the anterior incision was shortened and the danger of injury to the bladder during delivery considerably lessened.

Before an attempt is made to do a vaginal cæsarean section certain requirements are essential: (1) the tissues must not be oedematous or friable (2) the uterus must be movable so that the cervix may be readily brought down into the vagina (3) the bladder must not be fixed to the uterus as it is after the abdominal cervical cæsarean section (4) the pelvis must be ample (5) the child must not be too large. In the absence of these requisites the vaginal cæsarean section should not be considered regardless of the indication.

The range of usefulness of this operation has become rather limited since the advent of the abdominal cervical cæsarean section since the latter operation offers almost as much protection against infection and its technique is much simpler.

Vaginal cæsarean nowadays is recommended when one of the following indications for the rapid emptying of the uterus arises up to the end of the eighth month of pregnancy: (1) lesions of the heart, lungs and kidneys (2) toxæmia of pregnancy in the presence of impending convulsions and in gravide who did not improve under the conservative treatment (3) pernicious vomiting of pregnancy in a gravida who is dehydrated and who would not stand a long labor (4) premature separation of the normally inserted placenta in its milder forms.

Vaginal cæsarean section in the hands of experienced operators has given uniformly good results when its limitations were recognized. The main complication has been injury to the bladder but it does not occur commonly.

#### COMMENT

From the foregoing one may feel that from the standpoint of technique of operation there is not likely to be great improvement in the future.

Hæmorrhage during and after operation has been practically controlled. Complications from trauma of operation are rare. There is however one danger which has been lessened but the possibility of which we must always consider seriously and that is infection often leading to peritonitis. It is the chief cause of death following cesarean section.

Peritonitis may arise from the field of operation or the abdominal incision. Proper preparation of the patient and care at operation have actually made it a rare complication from the field of operation. Septic usually arises from the uterus through the introduction of septic material at the time of operation or from infection of the too tightly tied stitches in the uterus. To avoid peritonitis two operations were devised the extraperitoneal section and the transperitoneal section in which case the visceral and parietal peritoneum were united. The former never became popular because of its technical difficulties because of the danger of injury to the bladder and the ureters because serious infection of the cellular tissues resulted in long drainage and finally because it has been proved that virulent bacteria could find their way through the intact peritoneum the resistance of which had been lowered during operation and cause septic peritonitis. The latter operation was simpler in technique and gave equally good results and therefore supplanted the first in the hands of many operators.

It was next found that most infections were from inside the uterus rather than through the abdominal incision. The problem was to get ahead of the infection perhaps by covering the uterine incision with peritoneum. From this resulted the retrovesical or subperitoneal cervical operation at first with the longitudinal incision and then with the transverse cervical incision. This if infection has already occurred does not prevent the formation of a phlegmon under the bladder in the infected space but in many instances it does prevent the spreading of the infection to the general peritoneal cavity. The prevention of this localized infection is assisted in many cases through adequate drainage of the retrovesical space. This cannot be secured by abdominal drainage since drainage up hill is never very satisfactory but must be effected by vaginal drainage. A good method of draining consists in the placing of a wick of iodoform gauze over the lower segment after the cervical incision has been closed and then suturing the edge of the bladder peritoneum to the uterus thus covering the lower segment and the wick. After

the abdomen is closed the patient is placed in the lithotomy position a small incision is made in the anterior vaginal wall and the wick is partly pulled out so that one end remains under the bladder and the other comes out of the vulva or the wick may be entirely withdrawn and a rubber tube substituted and sutured in place. Either method assures gravity drainage of the retrovesical space. The increase of the resistance of the peritoneum against infection by such means as lavage with ether nucleic acid and other substances has not thus far proved satisfactory.

The work of Harris and Brown in the bacteriological study of 50 uteri at cesarean section has shown some interesting results. In 19 elective sections performed at an appointed time at the end of pregnancy and before the rupture of the membranes the uterus was uniformly sterile. The same applies to 6 cases in which the classical section was performed within 4 hours after the onset of labor. In 5 patients in whom classical section was done 6 or more hours after the onset of labor bacteria could always be demonstrated in the lower uterine segment and there were streptococci present in 3 of the cases. Similar results were obtained in 13 low cervical and 6 radical sections and the uterine contents were sterile only in 3 cases in which the operation was performed within a few hours after the onset of labor.

These findings tend to show why the classical section which in no way offers protection to the peritoneal cavity is safe only when practiced at the time of election. Vaginal examinations and premature rupture of the membranes are known to increase the danger of uterine infection but their absence does not insure sterile uterine contents. In a like manner a rise in temperature is an important sign of intrapartum infection yet a normal temperature does not prove that ascending infection has not already taken place. Only when adequate studies of the bacterial flora of the vagina have shown whether the occurrence of autoinfection is possible or not will we know whether the presence of bacteria in the uterus is due to an upward extension of microorganisms already in the vagina or to an ascending infection from the vulva.

The problem of preventing the growth of germs which may be present in the lower part of the birth canal or even in the uterus at the time of operation has been attacked through the care of the abdominal incision which will usually prevent infection here and through the care of the uterine incision in that the sutures are not

tied too tightly and the incision is covered with peritoneum. The danger of infection of the general peritoneal cavity has consequently been reduced but the invasion of the uterine tissue not incised as well as incised is still a great problem and should be thoroughly investigated.

The introduction into the uterus (intraperitoneal or subperitoneal perhaps in every case) of some substance which is non toxic or very slightly toxic to the patient and which will prevent the growth of bacteria temporarily or until granulations begin to form or tissues begin to heal may help decrease infection. Carrel Dakin solution after the extraperitoneal cesarean section was advocated by Markoe and McPherson some 10 years ago but the method thus far has not received general consideration.

At a recent meeting of the Obstetrical Society of Boston one of the members advocated the use of strong sugar solution in the uterus in the prevention of puerperal sepsis and in the checking of uterine infection if it has begun on the grounds that these sugar solutions inhibit the growth of bacteria. The problem of infection in connection with cesarean section is far from settled and it is one of the urgent problems in obstetrics.

From the standpoint of technique the transverse cervical incision in the low cesarean section offers many advantages. It is the closest approximation to normal delivery as the child is born through an opening less than 2 inches from the normal opening but above the symphysis instead of below it. The necessary room for delivery of the child can be easily obtained especially if the sides of the incision are curved upward. It is superior to the longitudinal incision since it can be placed entirely in the cervix and since it in no way encroaches upon the uterine corpus. It is easily covered over by the bladder and thus made entirely subperitoneal.

Drainage of the retrovesical area when deemed necessary can be easily accomplished by gravity drainage through the vagina. In cases of advanced labor with full dilatation of the cervix and rupture of the membranes it permits the expression of the placenta and membranes through the vagina after peritonealization thus saving the peritoneal cavity from a great deal of soiling.

Finally the convalescence which follows this method closely approaches that of a pelvic delivery.

## ACUTE PERFORATION OF ULCER FOLLOWING BARIUM FILLING IN ROUTINE GASTRO-INTESTINAL EXAMINATION

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THAT the roentgen ray used fluoroscopically is an invaluable aid in gastro intestinal diagnosis is a conceded fact. The use of this diagnostic method is attended by such a high percentage of accuracy that it would be unthinkable to hamper its use by too many contra indications. That there are contra indications however is generally recognized but possibly not at all times so keenly realized until some unforeseen complication focuses attention upon it. Casual searching of current literature has failed to disclose any reports bearing upon the unfortunate consequences arising from the making of a barium X-ray examination. In the discussion of a paper presented at a recent regional meeting of the American College of Surgeons reference was made to the cases cited later in this paper. Numerous admissions of such catastrophes were forthcoming from men in attendance at the meeting and it became quite apparent that such mishaps had occurred occasionally wherever gastro intestinal fluoroscopy was done routinely.

We have had at the Duluth Clinic within the past few years at least 5 cases of acute perforation of ulcer following barium meal with fluoroscopy. Two of the 5 perforations resulted fatally. In one case operation was performed too late and in the other a severe complicating pneumonia developed. Some indication as to the relative frequency of such mishaps may be obtained from the fact that approximately 1500 gastro intestinal examinations are made annually at this clinic. Although our cross index on ulcers diagnosed is undoubtedly somewhat incomplete it may be noted that during the past 5 years such a diagnosis has been made in 522 cases of which 82 per cent were cases of duodenal ulcer. We wish therefore to offer the following case reports and discussion.

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The patient decided to return home before entering the hospital for treatment but shortly after leaving Duluth was seized with severe abdominal pain. Operation was not obtained until 18 or 20 hours after perforation at which time much fluid and barium were found in the abdominal cavity. Closure posterior gastroenterostomy and drainage were done. The patient died 4 days after operation.

CASE 4 No 4710 C B male aged 46 years presented himself in September 1926 with the complaint of burning pain in the epigastrium of several hours duration and vomiting for 3 days. He had had previous attacks of the same sort of distress which had occurred 12 to 14 hours after eating. During the present attack he stated that the pain was definitely more severe and was relieved by food.

The patient was hospitalized for observation. After admission the vomitus was reported as coffee ground in appearance. On the day of admission a perforation of the stomach was shown by roentgen examination but no gross evidence of perforation. Accordingly barium was given and on fluoroscopic examination a very large defect was noted in the wall of the stomach itself was considerably dilated and atonic. The patient was returned to bed hot packs were applied to the abdomen and an attempt was made to move the barium from the stomach by lavage. After 12 hours after the fluoroscopic examination a perforation of the stomach was done 3 hours after the perforation at which time the excess barium was removed by suction. The wound was closed and a posterior gastroenterostomy was performed (the latter in view of obstructive features).

A postoperative lobar pneumonia developed on the third day and the patient died 6 days after operation.

An autopsy showed that the acute perforation had occurred and that death was due to bilateral lobar pneumonia.

CASE 5 No 44197 D M male aged 38 years Jewish had a known duodenal ulcer which had been demonstrated and treated medically at the Clinic during 2 previous attacks in 1925 and 1926. The entire ulcerous process was associated with rather severe indigestion and a recheck in February 1927 indicated an increase in size of the duodenal defect. Observation at the end of 6 hours showed a perforation of 50 per cent.

Surgery was advised and the patient entered the hospital the following day to be prepared for operation. About 36 hours after admission an acute duodenal perforation occurred. The operative procedure consisted of simple closure and a posterior gastroenterostomy from which the patient made a satisfactory recovery.

In reviewing this series one may observe that all of the patients were males in middle age. Four were within the age limits of 34 and 38 years. Although this may be only coincident yet one may surmise that perforation is not so likely to occur with the first or second attack nor again in those cases in which great chronicity would tend to protect by excessive scar formation. With regard to incidence one must remember of course that most ulcers have their initial onset in the third decade of life and that the proportion of males to females is about 5 to 1.

As to the location of the lesion four were duodenal and one was gastric which is in accord with the incidence ratio. That the injudicious use of the stomach tube could be a factor in the pro-

duction of a perforation of a gastric ulcer could well be understood but it would seem very unlikely that the same would obtain in the case of a duodenal ulcer. In the latter case in association with attempts to overcome spasm the actual weight of the barium assisted by forceful manipulation of the stomach would very evidently be a definite factor in the cause of rupture of ulcers at the pylorus or the duodenum situated as it were in the apex of a cone.

The length of time elapsing between the examination and the perforation varied in these cases from 3 to 36 hours. In Case 5 sufficient time had presumably elapsed between the filling and the perforation to have allowed the stomach to empty in spite of the tendency to retention. At any rate the operative notes make no mention of the presence of barium in the peritoneal cavity. For this reason the barium as a factor in the production of this perforation may be somewhat questionable and yet it may be fair to assume that the presence of this substance and the manipulation involved in the examination added greatly to the stress to which the weakened ulcer wall was subjected.

It might also be suggested at this point that the presence of barium in the peritoneal cavity makes for increased difficulty in removing the extravasated contents by suction or sponging and thus in all probability adds further danger to the already precarious condition of the patient with a perforated ulcer. In a review of the history of a patient the presence of certain symptoms should put the roentgenologist on his guard.

1 Evidence of bleeding is a well known and definite contra indication to the use of the stomach tube and barium filling. Yet in an unguarded moment one is apt to take an unwarranted chance so as to make a diagnosis with a minimum loss of time. With the evidence of recent bleeding as in Case 4 it was undoubtedly injudicious to attempt to make an X-ray diagnosis. Also it is probable that in this case the ulcer might have withstood the barium filling without perforation had not attempts been made later to remove the barium by lavage.

2 Increasing severity of distress as compared with the patient's previous experience may be interpreted as an indication of penetration.

3 Tenderness and rigidity in the epigastrium are unfavorable signs.

4 Failure of food to relieve as promptly and completely as previously is significant.

5 Occurrence of night pain in patients who in previous attacks had been free from this also seems to be of significance.



6 Excessive spasm as noted especially in Case 3 requiring considerable force to bring the cap into view should be regarded as a danger signal and should call for discretion as to the amount of force used in manipulation. This is especially true when the spasm is associated with a gross defect especially of the well recognized penetrating type.

It is not without hesitation that cases such as the illustrating in part at least errors in judgment and technique as well as entirely unforeseen complications are reported. Yet much of our knowledge must come through experience and by way of error and it is with the thought that these reports may serve to emphasize the necessity of exercising a certain amount of caution that they are offered.

At the Duluth Clinic it has become the custom to caution those patients in whom there is some reason to suspect any likelihood of perforation following a barium examination. Some of the patients are hospitalized and put to bed as soon as possible after the examination. Continuous hot packs are then applied to the abdomen. Other patients are urged to remain within

the city for the next 24 hours and to report immediately if any severe abdominal pain occurs. The situation here is such that the great majority of patients on whom these examinations are made are not primarily hospital patients and usually prefer to return home preparatory to entering the hospital for either medical or surgical treatment.

#### CONCLUSIONS

1 Five cases have been reported wherein acute ulcer perforations occurred following gastrointestinal examination.

Attention has been called to certain symptoms and fluoroscopic findings which point toward a tendency to penetration.

3 Within certain limits such signs and symptoms constitute contra indication to all or part of such examination.

4 Ulcer patients in whom the symptoms and findings are those pointing toward a penetrating type of lesion should be put on their guard and urged to remain within distance convenient for prompt and adequate medical consultation until the danger of perforation is passed.

## SPONTANEOUS HÆMATOMA OF THE ABDOMINAL WALL

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IN the literature of the past decade there have appeared occasional reports of so called hæmatoma of the abdominal wall the result of a rupture of the rectus abdominis muscle or of the deep epigastric artery. Review of the literature reveals that this apparently rare condition was known to physicians of antiquity. Thus Maydl in his classical contribution entitled "Subcutaneous Rupture of Muscles Tendons as well as Tear fractures" gives accurate descriptions of the condition as made by Hippocrates and Galen. In his extensive review of the literature covering the period from 1809 to 1880 Maydl found 14 cases of spontaneous rupture of the rectus abdominis muscle.

Since Maydl's investigation the subject has received attention principally at the hands of military surgeons of France, Germany, Russia and Austria. Their reports deal with cases occurring in vigorous young males principally soldiers and were the result of physical violence or effort. They were observed with greater frequency in recruits and were the result of jumping, lifting, turning, etc. A sudden unguarded movement was the cause in most cases. A sudden sharp pain was felt in the lower half of the abdomen. Sometime later at the site of pain a swelling of considerable size developed to the right or to the left of the median line. This mass disappeared in the course of a few weeks of rest and conservative treatment.

Wohlgemuth has collected 127 cases up to the year 1923. One hundred and seven of these have occurred in young muscular persons—soldiers, turners, etc.

A separate relatively small group is represented by cases occurring in women during pregnancy, parturition or shortly after delivery. The provoking incident such as coughing or vomiting is rather insignificant or it may be entirely absent. The fact that practically all of the patients were multiparæ suggests that impairment of musculature was a factor. Diagnosis of a twisted ovarian cyst was made in practically every case. In one case a large swelling developed shortly after delivery and was mistaken for the head of a second child.

Of greater interest to surgeons however are the cases of spontaneous hæmatoma of the abdominal wall occurring in elderly women without

any apparent cause. The contributing factor in these cases may be so insignificant as to escape notice. Most commonly it is the result of a cough or a coughing spell. There is usually an abrupt onset with severe pain in the abdomen associated with signs of peritoneal irritation such as belching, nausea, vomiting, obstipation, abdominal distention and muscle rigidity. A swelling which is painful on palpation develops either to the right or to the left of the median line. Diagnostic errors here are all due to the fact that it is believed that an acute intra-abdominal condition exists. The most frequent diagnosis is that of a twisted ovarian cyst. The condition has also been mistaken for an ovarian tumor, acute appendicitis, ileus, incarcerated hernia and cholelithiasis. The diagnosis of an acute intra-abdominal process is particularly suggestive in cases in which the hæmatoma develops in the lower third of the muscle below the semicircular line of Douglas. The absence at this level of the aponeurotic sheath on the posterior surface of the muscle permits the extravasated blood to bulge into the peritoneal cavity. In Wohlgemuth's series 79 took place below the navel and in 18 the rupture was below the semicircular line of Douglas. The muscle at this point is supported by the thin transversalis fascia only. It is also worthy of notice that the muscle below the navel is narrower and has less or no tendinous bands. It is interesting to note that in the 7 cases of spontaneous hæmatoma collected by Hilgenreiner up to 1924 not one was correctly diagnosed before the operation. The stormy onset in 1 case was mistaken for ileus; in 3 cases a diagnosis of twisted ovarian cysts was made. Koerte mistook his case for one of a gall stone colic. Behan diagnosed his case as one of acute appendicitis and in one case the diagnosis of an incarcerated hernia was made.

The onset is not always sudden. Blond has reported 1 case in a woman 73 years old who had a cough for about 6 weeks. For 3 weeks coughing caused a pain under the left costal arch. On examination there was found a swelling the size of a child's head with bluish discoloration of the skin over it. At operation there was found an encapsulated structure containing coagulated blood. Among the torn fibers of the rectus muscle was encountered a bleeding vessel, a branch

of the superior epigastric artery. The diagnostic difficulties are not limited to the consideration of intra abdominal conditions only. Even if the intramural existence of the lesion is recognized the true condition may still be confused with an incarcerated hernia, a tumor of the abdominal wall such as sarcoma, desmoid, fibroma or with gummata of the rectus muscle, tuberculosis or actinomycosis of the abdominal wall. Bloody discoloration of the skin may develop over the swelling, or about the navel with streaks running toward the symphysis pubis. This tell tale symptom however occurs relatively rarely because the extravasated blood is confined within the sheath of the muscle. It has occurred in only one of the 21 cases reported by Perman.

The pathogenesis in this group is not quite clear. The question as to whether the muscle ruptures first or whether the rupture of the epigastric artery takes place primarily with a secondary loosening and tearing of muscle fibers is a debatable question. One can readily concede that in the first group rupture of the muscle takes place first. In the absence of a violent effort degenerative changes in the muscle are responsible. Such cases have been observed in certain infectious diseases such as tetanus, typhus fever, miliary tuberculosis, etc. In the spontaneous hæmatoma of elderly women, obesity, pendulous abdomen and atheroma of blood vessels undoubtedly play an important part.

The diagnosis, particularly with localization in the right lower quadrant is confusing. Romanzew has suggested a valuable diagnostic point, namely that the limits of the swelling correspond to those of the sheath of the rectus. Thus the swelling does not pass the median line nor the lateral border of the rectus muscle.

#### CASE REPORT

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#### CONCLUSION

Spontaneous hæmatoma of the abdominal wall in elderly women presents a fairly typical clinical picture. Because of the possibility of diagnostic errors it merits the attention of surgeons and gynecologists. The sudden onset of rather severe pain followed by the development of a swelling which is very tender either to the right or to the left of the median line together with symptoms of peritoneal irritation should enable one to make a correct diagnosis before the operation. Operative interference is indicated both as the proper treatment of the condition itself and as a means of establishing a correct diagnosis.

#### BIBLIOGRAPHY

- BAUT. N. Z. F. g. d. r. p. t. n. e. t. d.  
B. h. d. k. l. m. a. t. m. Z. t. b. l. f. G. y. n. k.  
9. r. 96.  
B. I. A. N. B. t. n. M. & S. J. 9. l. x. 66.

- 3 BLOND K. Ueber das sogenannte Bauchdeckenhaematom des vorgerueckten Lebensalters Deutsche Ztschr f Chir 1924 cxxxviii 372-378
- 4 CHARVOT and COUILLAUDT Etude clinique sur les ruptures musculaires chez les cavaliers Rev de chir 1887 vii 325
- 5 CULBERTSON C Haematoma occurring spontaneously in the sheath of the rectus abdominis muscle J Am M Ass 1925 lxxxv 1955-1958
- 6 HILGENREITER H Das spontane Bauchdeckenhaematom des vorgerueckten Lebensalters ein Beitrag zur Spontanruptur des Musculus rectus abdominis Beitr z klin Chir cxvi 700-710
- 7 KORRTE W Chir Erkrankungen der Leber etc Diagnost und Therap Irrtuemer 90 iii
- 8 KOTZUREFF A La rupture spontanée de l'artere epigastrique et on traitement chirurgical Lyon chirurg 1921 xviii
- 9 MAYDL K Ueber subcutane Muskel und Sehnen Zerreissungen sowie Rissfracturen Deutsche Ztschr f Chir 1882 cxvii 306-361
- 10 PERVAN C Hematoma in the sheath of musculus rectus abdomini Acta chirurg Scand 1922 liv 5
- 11 ROMANZEW Ztschr f d ges Chir 1913 iii Abstracted
- 12 PENNER Z Ein Fall von spontanem Bauchdeckenhaematom des vorgerueckten Alters Zentralbl f Chir 1924 li 380-382
- 13 STOECKEL W Zwei Faelle von Bauchdeckenhaematom in der Schwangerschaft Zentralbl f Gynaek 1901 x 241
- 14 WOHLGEMUTH K Ueber die subcutane Rupture des Musculus rectus abdominis und der Arteria epigastica Spontane Bauchdeckenhaematome Arch f klin Chir 1923 cxxii 649-654

## SPINAL ANÆSTHESIA IN THE TREATMENT OF PARALYTIC ILEUS

By W E STUDDIFORD M D NEW YORK  
F m th St H p l f W me C l m b U ty

**P**ARALYTIC ileus is sometimes a very difficult postoperative complication to overcome. Although the great majority of cases can be relieved by common and widely known methods there occasionally occurs a case which is uninfluenced by them. It is in these cases that spinal anesthesia may often be used successfully.

Since September 1927 5 cases of stubborn paralytic ileus have been encountered in the Sloane Hospital for Women. They were all treated by the usual methods but without relief. After a fair trial of these methods spinal anesthesia was resorted to with more or less complete success. In 1 case the distention disappeared within 5 minutes accompanied by a copious evacuation of the bowels. In the others the effects came on much more slowly but all of the patients showed marked improvement within 4 hours.

### TECHNIQUE

The patient was placed in the lateral position and the back was prepared with iodine and draped. A needle was passed through a skin wheal of per cent novocain between the second and third lumbar vertebra into the spinal canal. About 6 or 7 cubic centimeters of spinal fluid was withdrawn and in this was dissolved 0.30 grams of novocain. The resulting solution was drawn into the syringe and injected into the spinal canal. Ten cubic centimeters of spinal fluid was then withdrawn and re-injected to aid in the diffusion of the solution. The attempt was made to obtain

an anesthesia reaching to the angle of the scapula as the splanchnics are said to receive branches from as high as the fifth and sixth dorsal segments. This was usually successful. After this the patient was placed flat on her back. No ill effects were noted except in one case in which there was a marked drop of blood pressure. The distention in this case disappeared within 5 minutes. The rapidly reduced abdominal pressure may have been a factor in producing the condition of mild shock. The latter soon cleared up. Some of the patients remarked on the immediate relief of symptoms and others quickly fell asleep.

The following is a brief summary of the cases that have been treated in this way.

**CASE 1.** Mr N M white aged 40 ii para ii gravida as admitted to the Sloane Hospital on July 7 1927 complaining of pain in the lower abdomen leucorrhœa and irregular menses. On examination it was found that she had a relaxed pelvic floor old lacerations of the cervix bilateral adnexal mass and a retroverted uterus. On August 5 a dilatation and curettage supravaginal hysterectomy bilateral salpingo-oophorectomy and hemorrhoidectomy were performed. Pathological examination showed an acute salpinx superimposed on a chronic salpinx. The patient was in poor postoperative condition with a low pressure pulse of 140. A hypodermoclysis was followed by considerable improvement. On August 6 the pulse continued to be rapid and vomiting began practically nothing being retained by mouth. Her temperature was 101 degrees F and respirations varied between 28 and 36 per minute. The condition continued until August 11 the sixth day after operation accompanied by increasing distention. Fluid was supplied by hypodermoclysis. Vomiting could not be controlled by gastric lavage. Enemata pituitrin

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185 pounds and resembling the pituitary type. Her feet and hands showed moderate edema. Pelvic measurements were normal except for a wide symphysis measuring 7 centimeters with a poor inclination. The bones were heavy. The clinical course of her pregnancy was normal. At one time she was hospitalized for 11 days because of mild hypertension. She was admitted to the hospital apparently in labor on April 18 at 7.45 a.m. She gave a history of rupture of the membranes at 3.00 a.m. She was having slight irregular pains. The fetal heart could not be heard but fetal movements could be made out. She was watched carefully during the next 24 hours but a no progress was made a cesarean section was decided upon. This was done at about 5.30 p.m. on April 19. The postoperative condition was good. On the morning of April 20 the patient's abdomen began to become distended. Large amounts of greenish fluid were vomited. During the next 24 hours enemata flax seed poultice tubes pituitin etc. were used to reduce distention but gave no relief. On April 21 the second day postpartum the distention was marked that the abdomen had become tense and drumlike. The temperature was subnormal the pulse was normal. The extremities were cold and clammy. The patient was in extreme distress. At 11.00 a.m. 3/10 gram of neocain was injected into the spinal canal. The anesthesia extended to about the fourth dorsal vertebra. Almost immediately after the injection the patient expelled a large amount of gas and liquid stool. The abdomen immediately became soft and the distention disappeared within 15 minutes. At about 11.20 a.m. the patient complained of faintness and blurred vision. The pulse was hardly perceptible. The blood pressure dropped to 55/30. This condition of mild shock soon passed. At 12.15 p.m. the patient again passed a large amount of flatus and feces. It is interesting to note that undigested spinach was present in the material expelled. On April 22 moderate distention was present. This was relieved by pituitrin and the rectal tube. This occurred again on April 23. After this the clinical course was uneventful. The temperature ran between 100 and 101 degrees falling below 100 degree on the tenth day postpartum. A slightly superficial wound infection was present. The patient is at present still in the hospital but can be discharged at an early date.

Although the observation had been frequently made that the intestines were found in a state of contraction and that incontinence of feces occurred following spinal anesthesia it was not until 1922 that the therapeutic value of this effect was emphasized by Wagner. He was soon followed by many others in the French and German journals. Grieg has reviewed these cases. Some authors have apparently become so enthusiastic about the method that they recommend it as a treatment for all types of intestinal obstruction to be

followed by operation if necessary. Grieg quotes Duval who has collected the reports of 400 cases and tabulated the results as follows:

	C	S	f	P
			l	t
Strangulated hernia	257	7	10	
Dynamia ileus	44	30	68	
Mechanical ileus	99	16	16	

He provides further data concerning dynamic ileus with which this paper is chiefly concerned.

	C	S	f	P
			l	t
Spasmodic	8	8	100	
Postoperative	11	9	90	
Ileus without obvious cause		2	100	
Ileus in peritonitis	18	10	55	
Pure reflex ileus (renal cl.)	1	0		
Ovarian cyst with twisted pedicle	4	1	25	

Markowitz and Campbell have used spinal anesthesia in the laboratory on dogs after producing ileus by chemicals or traumatic means. They have observed peristalsis carefully by means of barium meals and the fluoroscope and have noted that peristaltic movements commenced soon after spinal anesthesia was given and persisted in some experiments for over 20 hours. They offer the conception that paralytic ileus is a reflex inhibition of bowel movements. Starling states that the stimulation of the splanchnic nerves causes complete relaxation of the intestine while stimulation of the vagus causes increased contraction following a brief period of relaxation. He also suggests that the relaxed condition of the intestine in many abdominal conditions is probably due to a reflex stimulation of the splanchnic nerves which nullifies the motor action of the vagus. The probable explanation of the effect of spinal anesthesia in ileus is that the splanchnic inhibitory reflexes are blocked so that the vagus motor reflexes have full play.

#### REFERENCES

- GRIEG D. M. *Ldin M. J.* 1927 XXXIV 4, 5.  
 MARKOWITZ J. and CAMPBELL W. R. *Am. J. Physiol.*  
 1927 LVI 101-106.  
 STARLING. *Textbook of Physiology*

# EDITORIALS

## SURGERY, GYNECOLOGY AND OBSTETRICS

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DECEMBER, 1928

### THE RESPONSIBILITY OF THE SURGEON IN THE TREATMENT OF RENAL TUBERCULOSIS

A CAREFUL study of patients with tuberculosis indicates that this disease is not a local but a general one. A surgeon who considers the removal of a kidney because it is infected with tubercle bacilli must know something about tuberculosis in general. It is recognized that tubercle bacilli are carried to the kidney by the blood stream and that the organisms gain access to the blood from a primary focus which is most often in the lung. In other words renal or urinary tuberculosis is never primary. Patients who have tuberculous lesions in the lung very probably have lesions elsewhere; many of them unsuspected renal infections. Therefore physicians in sanatoria for the treatment of tuberculosis recognize the necessity of a complete physical examination of every patient. This applies to patients with urinary, pulmonary, or other lesions.

A complete history relative to exposure to tuberculosis which will reveal any possibility of infection during childhood should be obtained from every patient with a tuberculous

infection, whether the infection is in the lung or in the kidney. This history must contain data concerning any illness which the patient has suffered. Data relative to lung lesions alone are not sufficient; all possible symptoms of lesions elsewhere in the body must be studied carefully, as these may indicate to the surgeon whether or not infection has occurred in the intestine, in a bone, in the urinary tract, etc. Such lesions may be quiescent for many years but may become active at any time. A history of invasion of certain tissues of the body frequently explains unsuspected active lesions which are part of a general tuberculous infection and which may be entirely symptomless.

The small, early lesions found in the kidney are probably always bilateral and frequently heal. Reinfection may occur with return of active lesions and bacilli in the urine. Tubercle bacilli in the urine obtained from the kidney mean an active lesion of tuberculosis, whether shown by the pyelogram or not. Some of the small primary lesions may not heal and may develop into destructive lesions or phthisis of the kidney. Destructive lesions are most often unilateral, although they may be bilateral. Pathologists and clinicians have not been able to demonstrate a complete healing after a destructive lesion of more than microscopic size has developed.

Easily demonstrable destructive lesions of tuberculosis often remain quiescent for as long as two years, the patient being symptom free during that time. Bilateral destructive renal lesions were watched for two years in one instance with no progress of the lesions. The organisms disappeared from the urine and the

patient became symptom free but continued to have pyuria

Many surgeons insist that nephrectomy should be performed for renal tuberculosis as soon as the diagnosis can be made. This should be done provided the other kidney has no active demonstrable lesion and provided there are no active lesions of tuberculosis elsewhere in the body. Nephrectomy may safely be performed if the patient has been under observation long enough so that the surgeon is sure that he is able to resist tuberculosis. We have observed many patients with multiple lesions of tuberculosis in the urinary tract and elsewhere who have controlled the spread of the infection and have demonstrated their ability to heal at least partially some of their lesions. When such a case is encountered it is good surgery to remove one focus of infection such as the kidney because the surgeon is assured that with careful sanatorium treatment following surgery the healing processes which have already been started will probably continue. Patients have been observed with destructive lesions in one kidney and tubercle bacilli from the other kidney together with extra urinary active foci. Careful sanatorium treatment prevented the progress of the destructive lesions in the one kidney and arrested the extra urinary lesions and healed the tiny lesions in the other kidney. When this development of resistance is accomplished patients so treated recover promptly after nephrectomy are quickly rid of their urinary symptoms and have no evidence of activity in their extra urinary foci following operation.

When a surgeon advises the removal of one kidney which is known to contain a destructive process he must be certain that the other kidney is sound and has no active lesion of tuberculosis. He must also know the location and extent of other active urinary or extra urinary lesions of tuberculosis. Active extra

urinary lesions may not be considered a contra indication to nephrectomy if the patient has demonstrated an ability to arrest these lesions and therefore has developed a resistance against tuberculosis. Neither do I consider an active pulmonary lesion of tuberculosis a contra indication to operation provided that after a long period of observation the patient has demonstrated his ability to resist tuberculous infection.

Because tuberculosis is a general rather than a local disease the surgical removal of one kidney which rids the body of one focus of infection is merely an attempt to assist nature in the control of a general infection. A surgeon who removes a kidney in the presence of other active lesions should see that his patient is permitted to have sanatorium treatment following operation so that he may develop resistance against the infection. Often a patient comes to a surgeon seeking relief from urinary symptoms which are produced by tuberculosis of the kidneys with no other demonstrable lesions of tuberculosis. This patient may have an uneventful recovery following operation and is quickly rid of his symptoms because he has had active lesions of tuberculosis elsewhere in his body for many years and has built up a strong resistance against the infection.

The responsibility of considering surgery for renal tuberculosis is great. The surgeon must be prepared to do more than nephrectomy if he wishes his patient to be free from active lesions of tuberculosis. He must know whether or not his patient has active lesions elsewhere than in the kidney. Nephrectomy for renal tuberculosis must be preceded by sanatorium treatment in some instances and must be followed by sanatorium treatment in many other instances if clinical arrest of all lesions of tuberculosis is to be accomplished.

GILBERT J. THOMAS



## SURGICAL STANDARDIZATION

**I**F standardization is interpreted as the arbitrary dictation of certain specific steps to which all must conform it is bad. Initiative and independence of thought would cease. An adherence to dogma would tend to bring divergent conditions within artificially narrow limits. Even as in ancient days when the teachings of Galen were the inspired and unalterable basis of practice there would be created barriers to progress and help would be denied to suffering mankind.

If on the other hand surgical standardization is interpreted as the avenue for transmitting to the oncoming junior surgeons the benefit of the experience and judgment of the seniors then it were well both for surgical novice and for patient.

Surgery is employed to relieve local or general disease to repair damage or to prevent future disaster. Therefore surgery seeks to accomplish a benefit for the patient. The average patient convalescence completed should have obtained a net advantage. Average patient because until operative mortality ceases there will be those who do not live to attain the desired object. Not only is the patient entitled to a net advantage he is entitled to the maximum net advantage. Herein may standardization play its role. Whatever will tend to increase the degree of benefit and to minimize the occurrence of unhappy results becomes of necessity logical and desirable.

The point of prime importance in determining the management of any case is the efficacy of the selected program to accomplish the desired result. This however must be tempered by a consideration of the ratio of operative mortality risk to pathological mortality risk and also the ratio of postoperative morbidity or loss of function to that occasioned by the disease anomaly or injury. Whatever other

factors are taken into consideration the stamp of approval or disapproval must be determined by those three indices and they should be determined with mathematical accuracy—percentage of efficiency mortality ratio and morbidity ratio. An inefficient surgical program could not be tolerated. An efficient program that offered a higher death risk than the disease itself would violate the spirit of fairness that ought to dominate all civilized peoples. An efficient program of lower mortality risk than the disease yet carrying a serious risk of future morbidity would not survive in a humane community. Efficiency honesty humanity remain the basic criteria.

Subordinate to the foregoing major considerations but directly related to them are such matters as the conservation of anatomical structures the conservation of function the determination of when to intervene surgically and when not to intervene the choice between single and multiple stage operations and the selection of cases that could and should be referred to other clinics better equipped to undertake the necessary or indicated surgical program.

Truly the argument will be advanced that these are all matters of surgical judgment and each particular problem must be individually solved by the responsible surgeon. Granted but only in the case of mature and competent surgeons. This is the day and generation of rapidly spreading small community hospitals. Everywhere they are springing up as a response to a demand that is real and not to be denied. They are a boon to the communities that they serve. They are almost a necessity to the dwindling number of general practitioners in the outlying districts. However they are not without an element of danger. In so far as they lend encouragement to those unqualified in surgery to perform or attempt to perform operations on human beings they

are a menace to community welfare. Little does the patient or his relatives know of the basic qualifications of his family doctor to perform this or that operation. The patient knows that he is near home and that he is saving money by avoiding the presumably large fee of the so-called "specialist" and with those reassuring thoughts the matter rests. Sometimes the patient also rests—rests in peace forever after.

There exist then situations where surgical judgment is not available and cannot be brought to bear upon the problem. The small hospital has come to stay. The occasional operator will remain. There have been created legitimate fields for surgical standardization. For the younger generation of surgeons, for the infrequent operator, for those treading under compulsion on unfamiliar ground, it were well that there be some authoritative utterance. For the patient, it were even better that there be authoritative discouragement of the attempt by the novice to perform operations of election that are far beyond his scope.

Whence shall come the standards? Of necessity they must emanate from the larger centers. In direct ratio to volume of work will come opportunity to acquire a degree of judgment that may emancipate one from strict dependence on the dicta of others and permit

with fairness and equity to all concerned, a latitude of thought and action that might be fraught with disaster in the hands of a novice. From those who have attained this high degree of judgment the standards must be sought.

Who shall introduce the standards and enforce them? Shall this power be vested in a politically created and controlled board? Preferably not. Far better would it be for a purely professional organization, national in its scope, to undertake a task requiring to such a high degree the comprehension of the immutable laws of biology and pathology and also the mysterious workings of human psychology.

From members of the profession who have won the respect and confidence of their fellow practitioners there could be created a Board of Surgical Standardization with power to determine what surgical operations might be undertaken in any and every hospital equipped to do surgery and to intimate plainly what operations of election ought to be referred to specially equipped centers. For if surgery is to confer an advantage and if that advantage is to be the maximum obtainable advantage then the safest paths must be followed. Neither the patient nor his surgical advisers will suffer from clear guidance over the surest and safest roads.

ETHAN FLAGG BUTLER

# MASTER SURGEONS OF AMERICA

## SAMUEL LLOYD

**I**N the death of Dr Samuel Lloyd the country lost one of its foremost surgeons and a great teacher of surgery. He held an honored place in the older group of true general surgeons.

Dr Lloyd was born in Jersey City, New Jersey, on August 4, 1860, the son of Gardner Potts and Emma (Disbrow) Lloyd, and died on December 19, 1926. In 1888 he married Adele Ferrier Leck, who died in June, 1925.

His university work began at Princeton University, as a member of the class of 1882. He was prominent in various student activities, a noted athlete and head of the athletic association. During his course at Princeton he first began experimental work on animals in relation to thoracic surgery, in which work he afterward became a pioneer. From Princeton he went to the University of Vermont as associate professor of chemistry, and there studied medicine, graduating from the University of Vermont and later from the College of Physicians and Surgeons, New York City.

Any attempt to trace his career from that time until he took the Post Graduate Hospital Unit overseas at the outbreak of the World War would lead to unnecessary detail. Suffice it to say that with Dr St. John Roosa he was one of the founders of the New York Post Graduate Hospital and was associated with the progress of that institution until his death. Post graduate instruction and surgery in that hospital were profoundly influenced by him, and the list of his students, house staff, and associates would include many of the most prominent surgeons of today, scattered in all parts of the globe. It is related of him that one of his classes did not find sufficient thrill in doing their operative work on the cadaver, so in order to make it more realistic Dr Lloyd put a solution of red ink in a large container overhead and connected this with the veins of the cadaver, thus providing blood pressure. By means of a clock the supply was turned on and off at regular intervals, causing pulsation in the blood vessels. With this new apparatus the class proceeded with renewed enthusiasm.

During the early part of this period Dr Lloyd was associated with Dr L. S. Pilcher in the conduct of the *Annals of Surgery*, and from time to time contributed reviews, especially in spinal and thoracic surgery. At the same time he was making valuable contributions to all departments of surgery through his practice.



SAMUEL LLOYD  
1860-196

# MASTER SURGEONS OF AMERICA

## SAMUEL LLOYD

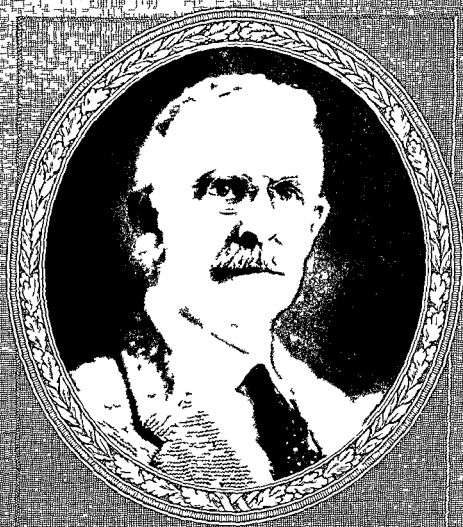
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SAMUEL LLOYD  
1860-19 6



and writings. He was the first to demonstrate that the expansion of the lung could be maintained by the patient without relying upon adhesions and mechanical apparatus. His contributions to the leading medical journals covering every phase of his work were sought for and valued.

He was associated in practice with Dr. James L. Little and continued Dr. Little's practice after his death in 1884.

At the time of the entry of the United States into the World War Dr. Lloyd enjoyed one of the largest surgical practices in New York City but abandoned it without hesitation and accepted active duty July 16, 1917. He had begun to organize the Post Graduate Hospital Unit in 1916 at the time of the Mexican trouble which led to General Pershing's punitive expedition. He completed the organization of this unit for overseas service later known in France as Base Hospital No. 8 and was in charge of it until January, 1918, later being appointed commander of the American Red Cross Hospital No. 5, with the rank of colonel.

During his service in France he received a citation from General Pershing for meritorious service in Base Hospital No. 5. He served with the British forces in the Cambrai offensive from October 15 to November 1, 1917. After the Armistice Dr. Lloyd was ordered to the University of Paris at the Sorbonne as representative of the American Expeditionary Force and was in charge of a large part of the educational work of the students of the Army from February, 1918, to July, 1919. In consideration of this work the Republic of France appointed him *Officier d'Académie Française* with silver palms and an *Officier de l'Instruction Publique* gold palms. His long years of teaching peculiarly fitted him for this kind of work and on his return to New York he was given particular praise by Surgeon General Merritt W. Ireland in whose words he was "a tower of strength to us in France."

A little later he became actively interested in the organization of The Veterans Mountain Camp in the Adirondicks and was treasurer of that association until 1921 when he was unanimously elected president in which office he remained for two years, refusing re-election on account of the condition of his health. During his terms of office he completed the organization of the Camp and placed it on a firm financial basis.

Dr. Lloyd had a wide and influential circle of friends who valued him for his charming personality and sterling and upright character as well as for his professional achievements. He took a keen interest in all public affairs and was an active supporter of many civic and private enterprises, giving liberally of his service and means. He regarded his profession as being of necessity largely philanthropic and expended much labor with no thought of reward. His many patients miss him greatly and his friends mourn his loss.

Three children survive him: Elizabeth (Mrs. E. H. Wardwell), Augustine (Mrs. J. P. H. Perry), and Samuel Lloyd, Jr.

CHARLES MURRAY GRATZ



# THE SURGEON'S LIBRARY

## OLD MASTERPIECES IN SURGERY

By ALFRED BROWN M.D. F.A.C.S. OMAHA, NEBRASKA

### THE SURGERY OF JOHN WOODALL

THE surgeons of the British Isles who lived and practiced during the sixteenth and seventeenth centuries do not at first glance appear to have left an great impression on the onward march of the science and seem to be overshadowed by their contemporary brethren in other countries particularly France and Italy. Reading the histories of the surgery of the period reveals this to be the general impression but further examination when made in the light of old politics and inherent racial traits will mitigate if not dispel this idea and lead to a more charitable view of their accomplishment.

During this period England was occupied in establishing herself as a world power and found a general empire which was to spread its dominion over the entire world. Her wars were different from the continental wars for in very instances it was necessary to transport her troops and up to the field of action. As maritime travels were so long and each campaign thus meant long absences from home and the restricted equipment in surgery on the ships of those days afforded no opportunity for research. All of the surgeons' services were left to us were various services in ships or on the field and not many of the contemporary of other nations attached to the court and living for political honors. Although the English surgeons are practical physicians the few of the sea and its surgery. They quote their ancestors but not much. They had no gratitude to consult so had to rely on the more common distributed works. When politics the practical directed towards the betterment of surgery and that in fits and starts to the omnipotent. During this period was the rise of the Barber Surgeon Company the Hospitals of London and the outgrowth of the faculty and practical schools throughout the British Isles. Look upon from the English through the time progresses as not great their accomplishment but not to be considered.

John Woodall a contemporary of these men. He was born in 1560 and learned his surgery in the field. When twenty years old he went to France with the troops. He remained in the continent for several years studying among other things he had no opportunity to observe and in at the Pest. This stood him good service for shortly after his return

to London the great epidemic of 1603 broke out. He remained in the city through the entire epidemic and left his observations which he called *A Treatise of the cure of the Plague* which forms part of his collected surgery of 1630.

Woodall became a member of the Barber Surgeons Company and in 1612 surgeon to St. Bartholomew's Hospital and Surgeon General of the East India Company. He organized the medical service of the East India Company and wrote his first book which he published in 1617 calling it *The Surgeon's Mate*. In it he describes the Surgeon's Chest and its contents and gives the treatment of the more usual diseases and injuries encountered both in peace and war. The most important of these surgery he recognized and treated with his motto.

When Great Britain extended her operations at sea 626 Charles the First called on the Surgeons Company to man the ships with personnel and organize the service. They in turn deputized the task to Woodall. Two years later in 1628 he published his *Vaticum*. The pathway to the Surgeon's Chest. This is devoted largely to gunshot wounds and intended as he says for the younger sort of Surgeons now employed in the service of His Majesty for the treatment of Rochell.

In 1630 *The Surgeon's Mate* and *Vaticum* were published and *A Treatise on the Plague* and *A Treatise of gangrene and sphacelus* added making a complete edition of his work which is a most interesting volume. In the surgery there is little new in fact Woodall goes back to old methods. His imputation technique for example is the pig bladder technique of von Guericke. This in spite of the fact that he knew of Paracelsus and his work for hemodialysis apparatuses he refers to John de Vigo Cal and Ambrose Paracelsus. He mentions suture of amputation wounds but does not speak of ligation of the vessels.

The charm of the book lies in the various little poems and allusions scattered through it and the allusions of the relative position of surgeon and internist. He believes the surgeon has as much right to give medicine as the physician. This was rank heresy. One of the poems introduced in a discussion is delightful.

Who likes approves and useful deems  
This work for him tis wrought  
But he that ligh thereof esteemes  
May leave the booke unbought

Benjamin Bell August 23<sup>d</sup> 1823.  
Edinburgh.



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# REVIEWS OF NEW BOOKS

THE publishers are to be congratulated upon collecting into one volume this series of scholarly addresses<sup>1</sup> by Sir Berkeley. No textbook or special article possesses the philosophical charm of these essays and their collection into one volume has made them far more widely accessible.

The volume contains many instances of the writer's skillful employment of word pictures for the purpose of bringing home his meaning more accurately. For instance he says: "We may therefore regard Hunter and Lister as bridge-builders; it is out of a multitude of scientific observations or opposite inferences and of wide generalizations that such bridges are built: stone by stone, arch by arch. Posteriorly will perhaps remember only the one bridge permanent, indestructible, all-sufficing of Lister. Across that bridge we have swarmed a triumphant host, and a vast new territory has met our almost incredulous eyes. Hunter was forever building bridges; ambition in design, firm in their foundations, but always left unfinished. Some day new architects will come and give them the full span which Hunter surely meant them to have."

The volume is full of valuable practical information. A very concrete example is the chapter on pre-operative and postoperative care in which detailed information is furnished the reader. One is pleased to note that Sir Berkeley suppresses the phlogotharic propensities of nurses. The indications for blood transfusions and the treatment of acidosis and alkalosis are given.

The science of surgery in days to come will be advanced by men trained in the methods and imbued with the spirit of experimental research, though it will no doubt be continued to be practiced to their profit by those who are merely craftsmen. Again, there are still among us brilliant operators from whom I pray to be spared when my hour has come.

The popular lectures upon cancer and upon Lister may serve as models to those who must address the public upon medical subjects. The author's opening address at Kings College Hospital on "The Approach to Surgery" contains much valuable guidance to the younger surgeon. He says: "nothing so easily destroys a man's capacity for thought and his delight in indulging in it (it is alas sometimes a torture)" as the restriction of his mental efforts to a limited part of a subject now hardly capable of extension.

The chapter upon Mental States and Organic Disease is full of interest. Sir Berkeley says that he endeavors to impress upon his students that the literal translation of Neurosis is "I don't know." He has become less reluctant to consider surgical treatment for obvious organic disease in those suffering from grave forms of mental disorder.

The chapters upon Perforation of Gastric and Duodenal Ulcers, Acute Pancreatitis and upon The Gall Bladder and Its Infections are illuminating and authentic presentations of these subjects.

FREDERICK CHRISTOPHER

IN their book on local anæsthesia in surgery of the head and neck, Fortmann and Leduc give the result of twelve years of the study and the application of the technique used by them at the University of Bordeaux. The book is systematically arranged in ten chapters covering the entire field of operative procedure upon the head and neck. The first chapter is devoted to a discussion of generalities and detailed description is given of all instrumentation and necessary equipment. In the following chapters individual procedures are discussed. The indications, the preparation of the patient and the anatomical considerations. Illustrations accompany each procedure. This makes a ready reference for a short review of any operation. The authors use local anæsthesia for all procedures about the head and neck. Radical mastoids, Killian operations on the frontal sinus, etc., are all done with one per cent novocain preceded by scopolamine morphine. It is the method of choice in all cases, and the authors consider it the best anæsthesia in curtailing the tympanic cavity. Sometimes a facial paresis results if the canal happens to be eroded. However, this is rare and usually recovers in a short time.

Four methods of applying local anæsthesia are described: injection, tamponization, topical application and spray. The last method is sometimes produced naturally, for when a solution of cocaine is injected into the trachea and the patient coughs, the fine droplets are deposited in the interior of the larynx.

The book is well arranged and is complete in all essential details: plastic surgery of the face, reconstructive surgery of the nose, broncho-œsophagoscopy and deep cervical anæsthesia are all included in this work. The illustrations are plentiful and well delineated.

The book is a valuable and needed contribution to otolaryngology.

JONAS F. DEPPA

MOST authors modestly refrain from attempting to teach their equals or their betters—hence the opening sentences of most prefaces admit that the book at hand was written for the student and general practitioner. The slight interest the latter has in the eye indicates that no satisfactory medium of instruction has as yet arisen. There are some simple truths that the practitioner should know, but no text or lecture has ever been presented which was not confusing because of too much detail and unne-

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does not find it necessary to keep turning pages continually in order to find the figures referred to in the descriptive matter

On the whole the author has kept in touch with the recent advances in surgery and has included that which is of lasting value but the section on the thorax might have been somewhat more extensive in view of the great strides in thoracic surgery and bronchoscopy. The use of the old terminology in the BNA nomenclature is somewhat surprising in a new text but does not detract from the fundamental value of the book. M. HALL MASO

IN his little volume<sup>1</sup> Orrin enumerates the conditions in which the transplantation of fascial lata has been found of value and describes the application of fascial grafts for the separation of superficial scars from underlying bone, the use of fascia in the repair of tendon defects as a protective investment for injured nerves as a substitute for loss of brain covering in arthroplasty and in the repair of hernia.

SUMNER L. KOE

FASCIAL GRAFTING IN PLASTIC SURGERY. By ORRIN, GEORGE L. (Ed.). Philadelphia: Lippincott, 1915. Pp. 105.

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# AMERICAN COLLEGE OF SURGEONS

## GRAND CURIOSITY<sup>1</sup>

By SIR SQUIRE SPRIGGE M.D. F.R.C.P. F.R.C.S. LONDON, ENGLAND

Ed: (The Lancet)

THERE is not only an adequate life of John Hunter in existence and an excellent skeleton life in the *British National Dictionary of Biography*, but for a long series of years official and pious orations have been delivered in his memory. Of these naturally the most important ones have been delivered in the theater of the Royal College of Surgeons of England adjacent to the Hunterian Museum that eternal monument which he erected to his own memory and the eulogy in every case have been published separately or in *The Lancet*. It is therefore unnecessary and indeed would be impertinent to describe in any detail to such an audience as this the life of Hunter, but in order to give meaning and coherence to the reflections which his tremendous work evokes in me at the present moment it is necessary to remind you of a few salient points and dates in his biography.

John Hunter was born 80 years ago on Valentine's Eve or day of 1728—at his father's farm near Glasgow. Youngest of a family of ten, he disliked school, hated books, lived in the open fields as far as was possible, studied animal life, especially birds and insects, mucked about (pardon the slang, there is no other appropriate expression for it) his father's farm, was apprenticed for a time to a relative, a timber merchant and cabinet maker, and with that odd equipment turned up in London at the age of 20 to assist an elder brother, William, who was at that time conducting a successful anatomy school in London. Of that school much has been written, but just before the bicentenary celebrations in honor of John Hunter, which took place in London last February, through the mediation of that famous disciple of Hunter, Sir Arthur Keith, and the generosity of Dr. Louisa Hamilton, there came into the possession of *The Lancet* a series of letters which describe from a contemporary pen the life of the Hunters at the time when this school was at the zenith of its work. The letters were written by Dr. Louisa Hamilton's ancestor, William Hamilton, to his father, Thomas Hamilton, professor

of anatomy in the University of Glasgow and a friend of the Hunter family. The fact that the Hunters were friends of the Hamiltons in itself indicates that John Hunter's father was in association with one of the most brilliant Scottish intellectual clans, for these were the Hamiltons, three of whom were professors of anatomy in the University of Glasgow, and one of whom, Sir William Hamilton, was the philosopher of world fame. Sir William Hamilton's grandfather, Thomas Hamilton, professor of anatomy in the University of Glasgow in 1751, was a fellow student of John Hunter, though his senior, and rode with John when he proceeded on horseback to join William Hunter in London in September, 1748. Later, namely in 1777, William Hamilton followed in the footsteps of his father, coming to London to study with both William and John Hunter, and the charming and informative letters which William then wrote to his parents tell an intimate story of the social milieu in which the Hunters lived and well indicates the absorbing way in which the anatomical studies of the school were pursued. The indications may be slight, but the picture which they draw is clear. They show an absolutely absorbing interest in the pursuit of science. They tell of social gatherings and jaunts of amusement, they deplore the results of alcoholic excess while they allude with approbation to the pleasure derived from moderate drinking, but throughout they describe a modest, intellectual society where the pursuit of knowledge was the object of life. The background of John's early career was in keeping with its famous developments.

So John became a medical doctor, and while he walked the medical school of St. George's hospital, he was all the time laying the foundations of and even elaborating new studies of comparative anatomy, collating what might be called the lessons derived from a lack of education as a boy with an intensive training as a young man. For one who was to become the greatest and most original comparative anatomist the world

has ever seen no better training could have been received than that of John Hunter which sounds like an indictment of all academic education. He knew the habits the mating times the sex differentiations the obstetric procedure and the farm farriery of a vast range of living creatures and being a genius (for had he not been a genius he never could have acquired remembered or sorted up his knowledge) he applied this compost of heterogeneous wisdom which was all teeming in his brain to the intensive study of human anatomy everlastingly asking himself why these things happened why these structures were so constructed why they underwent this or that change at this or that epoch and finding material for his answers by regarding the known facts of structural anatomy in the light of phenomena observed by himself. And in addition to all this he had unusual technical ability for the manual work of dissection. The inspiration throughout was a grand curiosity—What? and Why?

William Hunter was in particular a great teacher but he seems to have come the senior over John in an unfair way though it must not be forgotten that he had absolutely supported him rescued him from a life of vagabondage and set him on the road to fame and fortune. Anyhow John while William's assistant tried the descent of the testis in the fetus and made discoveries as to the nature of the placental circulation which William later claimed as his own apparently because they were done in his school.

Until he was just over 30 years of age John Hunter remained an anatomical assistant in his brother's medical school but it was clearly time that the brothers parted and in 1759 symptoms of lung trouble manifested themselves in John who was always a physically delicate man. Now this was a misfortune which in the event was a blessing. For it led to John Hunter applying for a staff appointment in connection with some military and naval operations being conducted off the coast of France—that is known as the Seven Years War being in course of decision. Hunter was stationed at Belle Isle and later in Portugal and used his opportunities by making assiduous and first hand observations on the anatomy and physiology of sea birds fishes and all marine zoology along its lower planes while at the same time he acquired a knowledge of military surgery as understood at that epoch studied the conditions of coagulation of the blood and probably made his first investigations as to the state among certain animals of hibernization. It was during this period presumably that he started his wonderful collection.

At the close of the Seven Years War he returned to London with a certain amount of half pay and a marvelous store of unrecorded wisdom to rely upon for a professional livelihood while he had increased his responsibilities by an engagement to Anne Home the daughter of one of his superior officers. He decided to teach anatomy while building up a surgical practice. He started to teach and to practice in Golden Square a square almost adjoining Peggott Street though so difficult to find which was at that time a residential district and although there seems to be no evidence that he made any particular mark at once he was able in the course of five years to find the money for the purchase of the lease of some land in the neighborhood of what is now known as the Earl's Court Road where he built a house. This was in 1765 but it was not until 1771 that he appeared to find time to marry Anne Home. In the meantime he took resident pupils in Golden Square held anatomy classes practised as a surgeon and continued to collect specimens. It was at this epoch that he secured the refusal of the carcasses of all the animals dying in the menagerie then attached to the Tower of London and as the menagerie was placed in the fosse around the walls of the Tower it seems likely that the death rate among the beasts was a high one. In one of the *Lives of Hunter* we find it related that he gave five pounds for a dying tiger and had to borrow the money from a book seller an anecdote which confirms the statement of Sir Everard Home that Hunter always kept himself penniless by disbursing all that he gained upon his collection. But Home's criticism of his brother in law does not consort with the facts that in 1765 Hunter should have been able to carry out such a financial transaction as that at Earl's Court while in 1768 he moved from Golden Square into a large house in Jermyn Street. He must have been making a substantial income as a surgeon or his profuse purchases would have drained his resources but the move to Jermyn Street was quite probably a wise financial action giving him more space in which to accommodate house pupils. For he was able to charge what was in those days the large sum of five hundred guineas for the privilege of apprenticeship to himself and it was in Jermyn Street that he received a pupil whose name is as widely known as his own namely Edward Jenner. In this way Hunter and Jenner came to be eternal ornaments to my hospital—St. George's.

Hunter's life at Earl's Court is the clue to his personality—it was one long exposition of his quality of an insatiable curiosity. It was the life of the curator of the most remarkable menagerie

the world has ever seen assembled in order that the inmates should give up to their owner the secrets of their lives the reasons for their being Mammals birds fishes and reptiles ranging from buffaloes to eagles from lizards to eels were there collected bred experimentally treated and cross fertilized where possible He transplanted the spurs of his cocks into their combs he fed swine with dyes till their bones were colored and every living thing under his care was watched in its periods of health development and pathological attack that it might answer some pertinent question in physiology Dogs and jackals horses and zebras were mated with a view to the study of the problems of fertilization and hybridization His early studies in aquatic zoology were continued in ponds specially dug to receive fish frogs leeches and especially eels the life history of which he perceived to be mysterious in vaults or dens he kept his larger beasts and seems to have been fearless in his management of them

Some of the multifarious directions whither Hunter's grand curiosity led him are revealed in a profuse correspondence which took place between him and his famous pupil Edward Jenner—a pupil after his own heart Nothing was known or even suspected during Hunter's life of what we should now describe as the phenomena of immunity nor was Jenner's first inoculation as a treatment for small pox performed until three years after Hunter's death but Hunter recognized in Jenner a kindred spirit Jenner became Hunter's intimate friend despite the fact that he was by twenty years the younger man and it was to Jenner practising in Gloucestershire that Hunter wrote from his country menagerie—it is significant of the spread of London that Hunter always alluded to Earl's Court as being in the country while it is now in the inner zone of the metropolis—outlining his doubts and asking for specimens to help him in their elucidation In the Vicary Lecture delivered in Lincoln's Inn last February during the Hunter Bicentenary celebrations in London Dr Peachey gave some interesting extracts from Hunter's letters to Jenner and as Baron's life of Jenner is now I understand difficult to obtain I refer you to Peachey's lecture for the following quotation Hunter keeps on asking for information as to the habits of the cuckoo and the breeding of toads and continues— If you collect eggs you should also collect the nests I want a crow's nest also a magpie's in the branches where they are built I want a nest with the cuckoo's eggs in it also one with a young cuckoo also an old cuckoo I hear you say there is no end to your wants Again he writes I

thank you for your experiment on the hedgehog try its heat and let me know the result You do not mention a word about bats Have you got the bones yet of a large porpoise? Is ever the salmon spawn seen after she has parted with it? I will take any specimen of fossils you may send me or indeed anything else What do you think of examining eels? Their sexes have not yet been found out nor their mode of propagation In the spring of 1778 he was asking for more hedgehogs All that you sent me have died so that I am hedgehog less And then in one letter after referring to some amatory disappointment suffered by Jenner he adds— Let her go never mind her I shall employ you with hedgehogs

This random series of questions covers it will be seen a huge range of physiology some of which later will have application in the actual practice of surgery It is easy to see what fundamental possibilities for physiological research lie beneath the demand for information as to the temperature of the hedgehog For the hedgehog is an animal which is for part of its life homothermal maintaining a uniform body temperature and for part of its life namely that spent in hibernation poikilothermic having a variable body temperature corresponding to the environment But how Jenner made the actual observations and how Hunter checked them with the kind of instrument that Fahrenheit had recently invented I cannot surmise and I must not pose as a student of Hunter's original writings He was as you might expect from a man of no academic training a bad and obscure writer while his observations were largely made in scattered notes It is quite possible that no notes on the matter exist It is sadly probable that they were destroyed for as is well known Sir Everard Home burned a large quantity of his brother in law's manuscripts

Now see where all this was tending and how it came about that Hunter while inventing comparative anatomy should also have become the father of modern surgery All the questions in respect of propagation among fish of vital processes among hibernaters and of the domestic habits of birds point to the intention to find some common law of life by which the normal and the abnormal as manifested in everything that lives moves and hath its being might be interpreted What we call physiology was in Hunter's day non-existent for the student Hunter's lifelong and intense experience as a dissector and teacher of anatomy made him realize that every advance in his knowledge of structure ought to be associated with some fuller comprehension of function Alterations in structure which he observed as regu-



lated by the age, sex, or development of the subject and equally so by morbid changes in the subject ought he felt to be explained by some general laws of life. This collector of specimens whose interest seemed directed with equal passion toward newts and luffaloes, eels and leopards, giants and dwarfs, was almost unconsciously working on a central plan while his interrogatories to himself and to his friends were so heterogeneous and so apparently disconnected. He was acquiring a new knowledge of physical processes and they occurred or might occur in man by drawing upon the lessons derived from his persistent observation of similar processes in animal and sometimes vegetable life. The time came when he felt that some pattern of life was regulating his observations of structural physiological paths to which then men. This he alluded to as the vital principle which he conceived as Leibniz's monads in his principles applied to matter a property well known to Lister.

He can only see the new arrival to it. In a sense we may be able at the present day to have advanced it much further than Hunter. What we have done is to fill in Hunter's line in the attempt to elucidate this property that we do not understand. As we have advanced difficulties not received from Hunter have arisen owing to the fact that Hunter's conception were entirely mechanistic and it is now fairly universally admitted that mechanistic explanations are insufficient the arena of dispute being the place at which his mechanism is more than a mechanistic solution called for.

But what Hunter himself would have found that any attempt to comment fairly upon it in a few words must be iniquitous and he would spend no time in discussing whether his philosophy might have led him if he were still with us. The central outcome of his work was practical and that is why he is the father of modern surgery and the range over which his teaching had a practical bearing was so vast that if for this quality only he takes his place with Harvey and Lister.

Harvey's work was as concentrated as Hunter's was diffuse. He was for many years of his life absorbed in the lucidation of one problem—the greatest problem in all physiology it may be granted but for its solution the necessary wisdom was likely to be of a concentrated sort. It was indeed likely—and so it proved in the event—that much of the necessary evidence was already in the possession of the initiated what was required being the sifting and marshalling of that evidence so that it should demonstrate the truth. In doing this Harvey was triumphantly success-

ful in what may be described as the finest piece of detective work that science can show and the perfection of that work is perhaps best manifested by the researcher's necessity to assume the existence of structures which were hidden from the naked eye until after his death. No general curiosity would have assisted Harvey's indulgence in it might only have served to divert his attention from the central problem. That his discovery by revolutionizing all conceptions of physiology had an importance ranging further than anything Hunter ever accomplished was due to its nature and not to Harvey's individual conceptions. Yet nothing that Hunter ever did would have had any meaning if Harvey had not supplied the sound physiological basis for the work.

Lister again was as concentrated in his work as Hunter was diffuse. The fact that Lister's immense discovery had as far ranging an influence over the comprehension of disease as Harvey's discovery had over the comprehension of physiology was due to the nature of the discovery and not to the discoverer's conception of his work. Lister like Harvey was a highly educated man both generally and specially for the task which he set himself and that task was in its original shape to prove that by precautions against infection the mortality accompanying certain cases of disease or injury could be prevented. By endless pains directed to that end he achieved his purpose and lived to see the limitless boon which he had conferred upon mankind in directions which he could not have foreseen. No general curiosity as to the laws of life would have advanced his researches.

Hunter was the middle term. Without Harvey's discovery all his wide ranging physiological researches as far as they could have been conducted would have been radically wrong in conception even though occasionally correct in deduction and many of the researches would never have been attempted. For example without a right knowledge of the physics of the circulation of the blood how could Hunter have transformed his observations on the blood supply to the velvet of the antler into comprehension of the possibilities of collateral circulation in the human subject with its result the devising of a radical cure for aneurism? And in a similar way the whole of Hunter's original surgical work was based we can assume safely upon his own physiological studies as he departed more and more from the traditional teachings of his day. How great the expansion of clinical surgery was under Hunter's teaching is best gathered from reading the treatise on surgery by his devout disciple Abernethy. This treatise

in the original shape was largely a reprint of Abernethy's lectures to his classes at St Bartholomew's Hospital which were printed in *The Lancet* in defiance of the lecturer's prohibition. This proceeding on the part of the founder of *The Lancet* was denounced by the leaders of medicine as a deed of flat piracy and hailed by the rank and file of the profession as a proper spreading of the gospel improperly withheld from them. The reporting of the lectures became the subject of furious action in law courts and the dispute was finally decided in Wakley's favor—to become I believe a leading precedent. It is a curious reflection that it should be easier to follow Hunter's teaching through the medium of his disciple than through his own words but it was the one ill result of Hunter's defective education that he was a poor and obscure writer. But the literary work that he had in view and died without accomplishment was surely an all round treatise on comparative anatomy and not a resumed application of his multifarious wisdom directed to clinical surgery. Of such a work the catalogue of his marvelous museum would have formed the backbone. Already the skeleton existed and much of the material wherewith to clothe the bones had been written—and re-written in obedience to the insatiable curiosity that kept him ever questioning,—when death took the author and a malignant fate consigned the work to treacherous hands.

If Hunter's theories, researches, experiments and results would have been impossible or vitiated or minimized without the sure foundation of the *De Motu Cordis* published precisely one hundred years before Hunter was born, so Lister's work which took definite shape some seventy years after Hunter's death would have been of infinitely less significance without the progress in surgical science initiated by Hunter and developed with the discovery of anæsthesia. Failing these things the application of Lister's theories must have been sadly smaller at first for many of the situations in which the combating of sepsis was the key to

the relief of symptoms and perhaps to the cure of the patient would never have presented themselves to the surgeon.

Gentlemen I hope that you will agree with me in finding that the leading characteristic of John Hunter was his Grand Curiosity—and how should it have been otherwise? Where could he have derived lessons from what accepted wisdom could he have imbibed and from what sources when he was inventing his science as he went along and knew not where his imaginings and their progressive realizations were leading him? Hunter's was the wisdom of the child who has the new game of life before him knowing neither the rules nor the chances but who learns to follow the first and meet the second by perpetually asking what and why?

It is out of no disrespect to you Sirs that I make my oration so brief. I anticipate your gratitude for my brevity. It has seemed to me that we should be paying higher honor to Hunter if instead of familiarizing or refamiliarizing ourselves with biographical details we considered one salient quality in his character which in my humble belief was the quality which counted first in all he did.

The rise from nail yard peasant to world famed philosopher, the life of piquant happenings, the self infection with the disease whose pathology he expounded and whose sequelæ were fatal to him, the dramatic death within the walls of St George's Hospital (the scene of his clinical triumphs), the holocaust made of his manuscripts by a trusted relative, the resurrection of his bones for burial in Westminster Abbey—all these things I know that you know of and I have spared you their repetition in order that I might ask you to regard this sensational hour in medical history as a child. But what a child! For he exercised his grand curiosity on the Master of All Things, demanding of Him from the evidence supplied by His creations what was the plan upon which He was working. Surely a Grand Curiosity.

THE EDUCATION OF THE SURGEON<sup>1</sup>

BY WILLIAM J. MAYO, M.D., F.A.C.S., ROCHESTER, MINNESOTA

WE meet tonight to welcome the incoming Fellows of the American College of Surgeons men who by reason of their character and ability have been selected by their state committees and by the officers of the College for fellowship. This is an occasion of importance in their lives and in the life of the association. We who are now bearing the burdens in time must lay them down for younger men to carry. The torch of learning is held by those who have gone before must ever pass to those who are to follow and who will cherish the ideals of the founders of the College.

Sir James Paget in one of his scholarly addresses of fifty years ago said that as man advances in age his body becomes more earthy (atheromatous) as though he were being prepared for the grave in advance of death. The old have the wisdom of experience. The young have their dreams and visions. The old and the young should travel together the old to point out the pitfall into which they have fallen the young to devise plans whereby they may avoid them.

The position of surgery forty years ago when I began practice can be illustrated by the events of a meeting of the American Surgical Association held at that time in Washington, D. C.

So called histerism had just come into being. The carbolic spray was producing a flog in the operating rooms and that talented surgeon the late Donald Ma Lean who was in attendance still showed the effects of an acute nephritic condition which had resulted from the carbolic acid vapor. A notable delegation of surgeons had come from England to attend this meeting and among the many excellent contributions made by them an outstanding American surgeon a few distinguished in particular stand out prominently in my mind.

Professor Durham from England a contemporary of Lister devoted his address to the subject of antiseptics.

That splendid surgeon Thomas Bryant of England who wrote the outstanding system of surgery of his time said that working under identical conditions with Lister he had just as good results and that all he did was to wash the wounds with a claret colored solution of tincture of iodine.

The great American surgeon Samuel D. Gross speaking of abdominal surgery said that surgery

had reached its height and that the recovery of the patient after an abdominal operation was a lucky accident at best.

Moses Gunn of Chicago made an eloquent plea for the elevation of all simple as well as compound fractures of the skull because of the danger of epilepsy.

Even in the short time the American College of Surgeons has been in existence the whole aspect of medicine has changed. The microscope brought revelations which through the work of Pasteur and Lister made possible man's greatest gift to man the mass prevention of diseases due to micro organisms. The protection that has been given to man in the mass is now being applied to the individual. Scientific research has gone beyond the realm of the microscope to invade the ultramicroscopic field of the colloids in which life itself resides. In the future the initiative of youth through the magic hand of research will produce in this field as startlingly significant changes in the foundations of medicine as the microscope brought in the past.

Patrick Henry in his never to be forgotten patriotic address said: "Our experience in the past is our only guide to the future." Perhaps it would be well for one of the older generation to comment briefly on those paths of culture and education which served most wisely to bring us to the present.

The University of Michigan my Alma Mater was one of the first schools to establish courses in medicine for three years of nine months each as requisite for a degree with at least high school training or its equivalent as a required preliminary. Anatomy, chemistry and the basic science subjects were taught as they were related to medicine. The sick man was the hub around which the entire education turned. The application of the art of medicine was based on the science of medicine.

In the light of the knowledge of the times the schools of that period turned out excellent practitioners of medicine. There were however a great number of medical schools in which the course consisted almost entirely of two series of identical lectures given over a period of four and a half or five months for which a degree was conferred. Of course there were also many medical schools of so low a grade that only by courtesy could the training given be called education.

The gradual change in medical education with its increasing cost and more stringent regulations by state boards of medical examiners for the right to practice in each state eliminated a large percentage of these inferior schools. The publication by the Rockefeller Foundation of Abraham Flexner's splendid report on the educational facilities of American medical colleges did still more to drive the inferior schools out of the field.

During the period of low grade medical education it was so easy for a person without culture and one might say with little knowledge of medicine to become a physician that the profession became crowded with ill trained men. As a result a general tendency developed to restrict medical education to those schools requiring of their students a good cultural background. As the medical schools progressed scientifically restrictions increased and today apparently there are too few physicians. Many communities which formerly had two or more physicians now have none. It is true that the great advances in medicine which have made possible the elimination of infectious and contagious diseases of all types have greatly reduced the necessity for individual medical attention and the automobiles, the good roads and the air crafts have made possible the rapid transfer of patients in serious condition a considerable distance to hospitals. In the northern states however inclement winter weather often makes this procedure hazardous if not impossible.

It is probable that the reduction in the number of physicians has been one of the causes of the increase of irregular practitioners. Many small towns that formerly had trained physicians now have only one or more untrained practitioners wedded to quackeries or cults and dependent on appeal to the emotions.

Without a desire to evaluate critically our present day methods of medical education I should like to comment briefly on some tendencies in medical school training. The swing of the pendulum from the poor medical school to the Class A medical school has brought a great increase in cultural requirements. Two years of premedical college work are requisite in all schools. Many schools urge or require three or four years of academic work preliminary to medicine and the education of the medical student is passing gradually from the clinician to the educator. By educator I mean the man who is learned in some particular branch of the science of medicine but who has little or no clinical background. Clinical professors hold less prominent positions than formerly and emphasis is placed on requirements

not always closely connected with the care of the sick. Many of the cultural requirements honor points and so forth in our medical schools appear to have been established not because they would necessarily make better physicians but because they cut down the number of students to those who can be taught conveniently. Often it is found that students who have been refused admittance to the medical department of the university would have been admitted to other departments on the same credits which by some circuitous reasoning are not considered adequate to admit them to the medical school.

There is no reason why the so called premedical cultural subjects should not include anatomy, chemistry and physiology and the so called basic science subjects. In the old school a cultural subject was one that could not be used for gain. The modern concept of culture is that the useful can be cultural. Too often the decision as to the qualifications of the applicant to the medical school rests on examinations in stated subjects which are memory tests and have comparatively little significance as an indication of whether or not the applicant will make a good physician.

Again there is a great delay in the age at which the physician begins practice after graduation from medical school. A survey of the graduates of one of our best medical schools showed that those who graduated in medicine before the age of twenty five on the whole were of greater professional value at the end of fifteen years than those who graduated after the age of twenty five. Still further showing the inadequacy of academic tests of ability at the end of fifteen years the graduates in the second half of the class in one of our most important medical schools were found to be of equal worth with those who finished in the first half. Such a comparison has no particular value except that it brings to mind the well known fact that it is difficult to determine without prolonged acquaintance just what are the future possibilities of a student.

We should consider also that there is a loss of at least one year and often two years in grammar school owing to the fact that the student is held to a graded course.

By the four quarter system one year's time can be saved in the medical schools. The world is on a twelve months basis of work. Why young persons at the period of life when they are strongest should have three months vacation in the summer I am unable to understand.

Another important consideration in medical education is that the knowledge of the educators themselves encompasses only a limited part of

medicine yet each one strives to make the student's knowledge limitless this cannot be done. The practitioners of medicine today realize that their knowledge can cover only a small part of medicine and they are dependent on their colleagues who are trained in the other fields of medical science. The result of the cramming in medical schools has been that our medical students have been taught to memorize and acquire knowledge rather than to think and acquire wisdom.

The teaching of medicine is expensive. For every dollar the medical student pays for his education either the state or endowment funds pay at least three or four dollars with the hope of giving the people better care when they are sick. Therefore any cause theoretic or academic that unnecessarily delays the student a year in his medical course is an injustice in all ways.

In England most of the medical schools are directly connected with a hospital and the entire training premedical as well as medical takes place in direct contact with the sick. It is gratifying to see that many of our schools are giving the entire fourth year of medicine in the hospital and are planning to add hospital training in the third year as well.

It is a waste of time for a medical student to spend three or four hours in a surgical clinic watching the removal of a brain tumor but he should be taught thoroughly to perform surgical operations in emergencies such as strangulated hernia, acute appendicitis and traumatism rather than the technique of the surgery of expediency in which time is not the supreme factor. In other words the specialized training of the surgeon must come after graduation in medicine.

The recent graduate in medicine who desires to become a surgeon should at once adopt some problem of research either in pure science or clinical investigation. It may be and probably will be that the research of itself will be of little value except to him but it will help to develop his scientific imagination that is the building of images to be compared with known facts. It will also teach him to appreciate the spirit of research which inspires many men even if he himself does not acquire this spirit.

I hope that the time will come when every young surgeon after special training of at least three years will take a master's degree in surgery and will train himself with a view of gaining surgical recognition that will entitle him to join the College.

The American College of Surgeons received its early inspiration from the Royal College of Sur-

geons of England Ireland and Edinburgh Scotland. We cannot be grateful enough to the surgeons of Great Britain who came here in the early days and gave freely of their time and wisdom in helping us to organize our College. These men have a background of knowledge and culture which goes back to the early historical period of medicine. I do not know of a finer group of men than those of the Royal College of Surgeons.

In some respects however the problems of the American medical profession are different from those of the British. In England for instance with its excellent train service, splendid roads and short distances it is easy to transfer a patient to secure proper medical service and its many cities make hospitalization possible. In Canada and the United States with their 130,000,000 people and vast distances it has been necessary to organize with a view to the surgical care of the sick and of furnishing enough surgeons adequately trained to do this work.

Consequently the training required for entrance into the American College of Surgeons is that which can be met by the facilities of our best schools and the College is gradually elevating standards as the necessary educational facilities are afforded.

The American College of Surgeons has established a ruling that an applicant for fellowship is not eligible until seven or eight years after graduation from medical college. This plan was adopted in order to show that the applicant is not only a man of science but also that he is adequately prepared to practice the art of surgery. During these eight years this splendid period of what might be called the novitiate the applicant may become a member of the Junior Candidate group of the College membership in which acts as a stimulus to fulfillment of the senior requirements and gives opportunity to make headway. Every man of character energy and brain power may reasonably hope to become a member of the American College of Surgeons.

I would emphasize the enormous advance that has been made in medicine and how dependent the surgeon is on his fellow practitioners for specialized knowledge. When I began the practice of medicine rarely were the two physicians of a small town on speaking terms. Rumors carried about by over zealous friends and former patients had produced a condition of intolerance which constituted the greatest enemy of the medical profession.

The physician of all others is and has been an individual to an almost incurable individual.

The quarrels among physicians have been notorious and the irregular practitioners have taken advantage of this fact. In the past for a time ethics became ceremonials and during this state of affairs the people were educated by the patent medicine advertiser the quack and the cultist. Individually physicians had influence collectively owing to this professional intolerance they had practically none.

Today conditions are different. Every community with civic pride is establishing or has established a community hospital. The expense of sickness in the home and the attendant location of the household has resulted in treating serious illnesses in the hospital. The physician now bends his every effort to learn some part of organized medicine which with the aid of his colleagues will best help to make a whole.

Group medicine has been misunderstood because it has been talked about so much from the financial standpoint. Fundamentally group medicine has nothing to do with finance. Working arrangements can be made whereby each patient rich middle class or poor can receive necessary attention collectively each consultant rendering a bill for services rendered. By agreement the total charge in each case can be brought within the limit of the patient's means. Every physician worthy of the name is practicing group medicine. He is getting diagnoses of contagious and infectious diseases through boards of health X-ray examinations through radiologists and laboratory examinations through technicians. His duty is to learn to evaluate and apply the results of such scientific machinery to the living patient.

Physicians should be paid for attendance on county charity patients just as the county attorney and the county engineer are paid for doing their work and governmental agencies should pay a proper hospital fee in charity cases. Too many times the city and the county will be found paying half or a third of what it actually costs for the hospital care of the patient for whom they are responsible and this extra burden of expense is thrown on the common man when he enters the hospital. President Lincoln once said that the Lord must love the common people because he made so many of them. It is the common people the energetic industrious and frugal class who keep the world going and pay the bills.

It has been said that advice is easy to give hard to take and usually of little value. As I look back over my experience in the practice of medicine I can see that I have learned much not only from my own experience but from watching the careers of men who began their professional

lives full of enthusiasm energy and hope. Some of these men have made great progress some have made moderate progress and others after a brief flash have made little progress.

Of the three learned professions the church and the law deal with subjects more or less closed. The church is concerned with carrying out precepts and examples of 500 years ago. The law depends on precedents established by the yesterday of life but in the profession of medicine tomorrow is the great day.

The brain of man is a visual brain. This is not because the eye of man is mechanically superior to that of other animals but that it leads directly to consciousness and whereas in man the thinking brain the cerebrum has been built around sight in the lower animals it has been built up from the olfactory ganglion.

Napoleon said: Every man is a coward in the dark. The predominance of the sense of sight tends to induce emotional instability in the individual exposed to either physical darkness as a spiritualistic seance or mental darkness in the presence of the unknown the state of mind which prompts a boy to whistle when crossing the churchyard at night.

I have known many promising young men who in the springtime of their lives have allowed themselves to become interested in blind alleys of belief the occult things which are incapable of proof and which loosen the mind from the moorings of fact.

The surgeon must give intelligent thought to the general problems of social contacts but with a decent respect for the opinions of mankind which will give him tolerance for other people's beliefs and make him less impatient of their infirmities. In youth he should travel in an orthodox manner with the majority that he may save his mental efforts for his chosen profession. In age he can follow the example of Sir Conan Doyle and Sir Oliver Lodge because after all they have reached a time of life in which blind mental exercises may afford relief in their leisure which many receive through more healthy channels such as golf.

Systematic medical study is of the greatest value to the surgeon. I began by charging myself with one hour study a day and I did not give myself credit for advance work that is if I put in three hours I took credit for one. I was scrupulous however in making up the deficit when it happened that I was unable to study. It is surprising how much one can accomplish by steady adherence to this type of program. The reading should be catholic. To the young surgeon

I would say do not read all surgery and technique for technique is constantly changing. We abandon methods or procedures which were perfectly satisfactory for something which is no more satisfactory as the ladies do their bonnets. Along with surgical literature read medical articles in high class medical journals. Do not skim but here and there select certain articles and read them with care especially those that have a physiological background.

Further I would advise the young surgeon to write papers and in writing to bear in mind what the old minister said. Few souls are saved after the first fifteen minutes of the sermon. Write the paper not to show how learned you are or to show the high type man who may be in the audience that you are in his class. I rather try to tell those in your audience who perhaps may not know as much about the subject as you do something that may interest and help them. Do not try to make too many points. The late Dr. A. J. Ochsner used to say. If I can carry three lessons in a paper it is about all that the average man whom I want to reach can absorb at one sitting anything over five would probably be lost.

Always remembering that man's brain is a visual brain use illustrations drawings and lantern slides to emphasize points that you consider really important.

In urging you to write I do not wish to stress the idea that your paper will be valuable to any one but yourself but they will be of incalculable worth to you because they will crystallize your idea and will bring forward questions that you have not answered and must study further.

In delivering paper and address begin by presenting them before small societies and work up to the national organizations. You will find men in the small societies equally as bright and eager to learn as you will find in the large societies.

In your spare time the curriculum of a clinical investigation of a research character will add to the interest of your contributions before medical societies and especially will train your mind.

Finally you may become a good operator by staying at home and attending strictly to busi-

ness but not a good surgeon. It is the mental outlook of the surgeon and not the hands that is most important. The late Sir Frederick Treves said that he would rather be operated on by the sound surgeon with parkinsonian disease than by the surgeon with steady hands and an unsteady mind.

You cannot get surgery from books and journals they help but you must see surgery. All my professional life I have been a frequent visitor at the clinics of other men. When I have heard of a man who was doing something unusual and have been confidentially warned by those who lived in his community that he was a liar I have gone to see him and usually have found that he had something worth while.

Visit surgical clinics at home and abroad but do not see too many on one visit so that you will come home with a confused viewpoint. You do not want merely to see patients operated on if it is blood you are looking for go to the stock yard. Go away with a definite object and concentrate on that. Choose a few good surgeons study their method. If necessary stop a while to take special instruction in physiology anatomy or chemistry to make the subject clear to you.

Be thorough yet efficient. We see many men who are thorough that is they acquire a prodigious amount of information but they are inefficient because they do not understand relative values. They have heaped up two cent pieces so to speak which they have not distinguished from twenty dollar gold pieces.

As a last admonition do not go away to criticize you will find plenty to criticize in your own operating rooms. See only the things that are done better than you do them and be blind to the things that are not so good.

In conclusion I desire to express my gratification that I have been privileged to deliver the convocation address during the presidential term of the founder of the American College of Surgeons the man who has given the fruitful years of his life to the development of the ideals of the College and to directing its spiritual outlook. Dr. Franklin H. Martin.

# THE AMERICAN COLLECT OF SUCTIONS—THE PAST THE PRESENT, AND THE FUTURE<sup>1</sup>

By FRANKLIN H. MATHIAS, M.D., CHICAGO, ILLINOIS

## I. THE OLD GUARD VERSUS THE NEW GUARD

THE years 1883 to 1900 were a transition period in American surgery and brought us from laudable pus to the conception of aseptic surgery from rapid spectacular technique to deliberate and refined methods in operation.

We had been blind followers and this was the meaning of our independence. Science had given us facts and we began to reject the facts. Though they did not always agree with our procedure based on traditions and from foreign teachers and literature we began to do our own thinking. The leaders of this renaissance were maturing. They had inquired and they were not yet so sure of themselves that they had become provincial. They argued.

We may not be right. Let us see what our confreres are doing. In this way we may find something to imitate or we may learn what not to do.

Meanwhile there were pathfinders who were being watched and criticized. They were going too fast even for some of the most progressive. Senn had written into the history of surgery his initial chapter on the development of internal surgery. Fenger had coupled pathology with surgery. Murphy was altering traditions. The Mayos were building if not better than they knew better than we knew. Thus miracles were in the making.

In substance George said to Harvey. Let us as a group get together and watch one another operate. Let us criticize talk out in meeting and each get the standpoint of the other. Let each of us know what all of us know and let us take our knowledge at first hand from those who are doing things rather than from those who are talking and writing about them.

And thus the Society of Clinical Surgery was organized in July 1903 an act that gave to the surgery of the world and to the conservation of surgical patients the greatest impulse since the work of Pasteur and Lister. It taught a group of leaders the best methods current not only in the United States but in all civilized countries.

Such advantages could not remain exclusive. Other surgical specialists imitated. One clinic and another were established they welcomed those who wished to observe the work of others and became the mecca for aspiring surgeons.

## II. STIMULATION OF CLINICAL LITERATURE

This was the soil that was being fertilized and it followed with possibilities of a great crop.

A speaker became interested in this project and went one Saturday at a popular dinner the meeting of the Society of Clinical Surgery. We are our glorious spectacle the earnest interest of the leaders from all of our great clinical centers their constructive criticisms and the intelligent replies in the amphitheater the eager eyes of a hundred other surgeons not members of the Society men from the provincial towns of the United States and Canada who were also well educated in the art. Later at the informal round table all were gathered to review the work of the morning and to enter into free discussion.

Seventeen years earlier in 1905 SURGERY GYNÆCOLOGY AND OBSTETRICS was established to record the work of men who were actually doing surgery a practical journal for practical surgeons edited by a practical surgeon rather than by literary writers remotely connected with clinical work the profits from the journal to be utilized in strengthening its influence and not put into the pockets of business promoters. This journal had been welcomed and supported by wellnigh every surgeon in the interesting audiences of that day and this experience with the journal influenced much the silent observer. What did it mean? Was there ever a greater manifestation of interest in surgical work and were there ever more constructive discussions?

Did it not mean that these men as practical practitioners were demonstrating that there existed an unorganized demand for a new form of medical society to supplement not to displace the time honored associations a clinical rather than a purely academic body a show me rather than a tell me society? The leaven had become implanted in the mind of the silent observer and the leaven became insistent in its development.

A trip had been planned which involved a sea voyage to the Mediterranean. This individual took ship accompanied by an inspiring and brunny woman rightfully ascribed as his lawful wife. The decks were broad the leisure ample and the ship afforded opportunity for miles of deck walking which was stimulated by the implanted leaven.



## III THE CONCEPTION

The question was How could we make accessible to the many aspiring surgeons what was being enjoyed by the exclusive few and how enable them to see not only a few clinics but to observe the work of the individual surgeons of these privileged groups?

The solution came suddenly like a flash of lightning. The initial problem was visualized the technique approved and plans formulated. The blue of the sea reflected no flaws the soft tropical breeze brought forth no criticisms. The heaven at last had brought forth results and these results were poured with enthusiasm into the ears of the often critical companion. The blue of the Mediterranean again approved as reflected in sympathetic eyes and no trace of criticism came to mar the scene. The highest court had approved. The Clinical Congress of Surgeons was conceived.

## IV THE CLINICAL CONGRESS OF SURGEONS OF NORTH AMERICA

This was February of 1910. There and then it was decided that the 3,000 subscribers to SURGERY GYNECOLOGY AND OBSTETRICS should be invited to Chicago in November of that year as guests of the journal to observe at first hand the work of the leading surgical clinicians of that mid-western city.

On November 17th of 1910 the first day of the two week session we waited breathlessly and anxiously for the response. Many acceptances had been received—so many that it seemed too good. It was ominous. The first day 1,100 registered 1,600 finally. Many were in attendance who did not register.

On November 19th a notice signed by the late Dr. James B. Egleston of Seattle was bulletined at headquarters which asked any who were interested to attend a meeting for the purpose of making permanent the organization. Several hundred of the visiting surgeons accepted the invitation and a formal association was perfected by name.

The Clinical Congress of Surgeons of North America. John B. Murphy appeared on the floor thrilled the audience by a rousing speech of commendation and nominated Albert J. Ochsner as the first President.

The informal meeting demonstrated beyond a doubt the demand for this new form of organization. Your orator was called to Philadelphia on December 6, 1910 met a group of Philadelphia's leading surgeons at the residence of John G. Clark and accepted the invitation to hold the 1911 Congress in that city.

## V DIFFICULTIES

The Philadelphia Congress was held in 1911 with a stipulated fee for those who attended sufficient to pay expenses. Eleven hundred were registered and the leaders of surgery in the Quaker City furnished a magnificent program of clinics. John C. Clark was chairman of the Committee on Arrangements. Edward Martin was elected President and New York was selected as the host for 1912.

It had become apparent in these initial meetings that some means should be adopted to limit the attendance to the registered surgeons some means of limiting accommodations at clinics to ticket holders some means of enforcing the hospital to recognize tickets as a requirement for admission some means of establishing an authority that would include only acceptable clinics at each session of the Congress some means of determining who among the clinicians of the city acting as host should be invited to give clinics. Standards ethics and the general acceptability of guests and clinicians were recognized as acute problems.

During the year there had been much discussion of our problem among those of us who were responsible for this movement. Some were sympathetic and others decidedly discouraging as to the wisdom of continuing this ambitious innovation.

## VI LOOKING TO PERMANENCY

Your speaker received many hints from the extensive discussion which on careful study offered a solution of the obvious difficulties and gave promise of one more long advance in progress of organized surgery on our continent. The substance of this plan was dictated to the public stenographer of the Twentieth Century on a journey from Chicago to New York preliminary to the 1912 meeting.

On arrival in New York this plan was submitted with feverish enthusiasm to John B. Murphy who was routed from his morning bath to receive the impatient emissary. Dr. Murphy clothed in a bath towel reluctantly canned the improvised plan. As he read his expression grew more and more sympathetic and as he finished he enthusiastically asked the privilege of seconding and supporting the plan when it was submitted at the mass meeting of the Clinical Congress.

The prospectus was then submitted (not without fear and trembling) to our autocratic President Edward Martin. Meanwhile the document had been put into the form of a resolution which provided for the appointment of a committee of

twelve with power to act, which should proceed toward the perfection of the new organization which was to be closely allied with the Clinical Congress and would aid it in controlling the personnel of its members its clinicians and its moral and ethical regulations

Friday afternoon November 15 1911 the plan was presented by your speaker to two thousand of the surgeons in attendance at the Congress Doctor John B. Murphy seconded the resolution which recommended a plan for the organization of an American College of Surgeons

President Edward Martin lost no time in urging the importance of the movement and with a few choice words of warning against imitating all this pomp and circumstance of the effete past he commanded a rising vote in favor of the resolution This vote carried with it the appointment of a committee of twelve on organization a majority of whom were selected almost exclusively from among the old guard of progressive surgeons who comprised the Society of Clinical Surgery as follows Edward Martin Emmet Rixford John B. Murphy Rudolph Matas Albert J. Ochsner Charles H. Mayo Frederic J. Cotton George Emerson Brewer John M. T. Finney Walter W. Chipman George W. Crile and Franklin H. Martin

During the succeeding six months Franklin H. Martin a member of this committee visited the leading cities of the United States and Canada He conferred with groups of surgeons selected by subcommittees and called together local men of prominence to take part in the discussion These amplified groups numbering five hundred and fifty surgeons were invited to a meeting on organization to be held later in Washington D. C.

At the appointed time May 5 1913 450 leaders in the surgical profession appeared in Washington to assist in or protest against the establishment of an American College of Surgeons Under the skillful chairmanship of Edward Martin enthusiasm was stimulated criticism modified opposition discouraged a constitution and by laws adopted officers a Board of Regents and a Board of Governors elected and November 13 1913 appointed as the date for the first Convocation of the new College

Again the surgeons of all America honored the group comprising the Society of Clinical Surgery the old guard with a majority among the officers and Board of Regents The original Regents have become the veritable wheel horses of the College They were as follows John M. T. Finney President Walter W. Chipman and

Rudolph Matas Vice Presidents Albert J. Ochsner Treasurer Franklin H. Martin Secretary General George E. Armstrong George E. Brewer Herbert Bruce Frederic J. Cotton George W. Crile William D. Haggard Edward Martin Charles H. Mayo Robert E. McKechnie John B. Murphy Harry M. Sherman, and Charles F. Stokes

To these from time to time other surgeons possessing vision and executive and administrative ability have been elected to aid in steering our course among whom I especially wish to mention Frank F. Simpson William Crawford Gorgas Harvey Cushing William J. Mayo Alexander Primrose William C. Braisted George E. de Schweinitz J. Bentley Squier James B. Eagleson Charles H. Peck Daniel F. Jones Frederick W. Parham Jasper Halpenny Merritt W. Ireland Allen B. Kanavel Arthur A. Law Frederic A. Besley Herbert S. Birkett John B. Deaver Henry H. Sherk Lincoln Davis John G. MacDougall Ernst A. Sommer Charles E. Kahke Robert G. LeConte Horace Packard Charles E. Sawyer George P. Muller Frederic N. G. Starr Robert B. Greenough John S. McEachern John G. Clark George Henry Murphy George David Stewart Frank H. Mewburn Irvin Abell A. T. Bazin G. A. B. Addy C. Jeff Miller Harvey G. Mudd Eugene H. Pool Clarence L. Starr Charles F. Nassau Truman W. Brophy J. Chalmers Da Costa John O. born Polak and Herbert P. H. Galloway

Particularly do I desire to acknowledge the time serving work that has been conspicuous for its loyalty and disinterestedness in our Directors Associate Directors and Secretaries including John G. Bowman M. T. MacEachern E. I. Salisbury Allan Craig Judge Harold M. Stephens Bowman C. Crowell A. D. Ballou Marion T. Iarrow and Eleanor Grimm

## VII EARLY ACTIVITIES

In initiating this new kind of society there was little justification in the venture unless some thing of outstanding value should come from it The group of men who were in at the beginning were not politicians seeking personal prestige they were busy surgeons who were occupied in the practice of scientific medicine What was the idea? Why another society?

The purpose was to organize 1. A comprehensive association of practical surgical specialists and do on a large scale what the Society of Clinical Surgery was doing on a smaller scale viz enable visiting surgeons to see surgical confreres at work in their respective environments discuss

with them problems based on practical surgical experience rather than listen to literary treatises based on theoretical deductions

2 A comprehensive association that would conscientiously enroll those surgeons of the American continent as in the opinion of their confreres were competent to do surgery were morally and ethically reliable and would support the ideal of our profession an association which would welcome into its ranks any individual licensed physician whose credentials under proper scrutiny measured up to stipulated requirements and through which the public by dignified means could recognize and obtain the services of such qualified men

3 A comprehensive association that would with all of its resources oppose financial chicanery (commonly known as fee splitting or the buying and selling of patient) between the medical practitioner and the surgeon and so far as possible exclude from its ranks all offenders

4 A comprehensive association that would seek by every legitimate means to protect the public from incompetent dishonest and unbecomingly surgery that would assume leadership and co-operation with all resources of organized scientific medicine toward the improvement of hospital laboratories dispensaries medical schools—in fact every environment in which surgery and medicine may be taught or practiced

5 A comprehensive association that would cooperate with the people obtain from them the benefits of scientific advice furnish to them the services of preventive medicine and educate them to distinguish between the reliability of scientific medicine and the false spinstries of quackery

How well we have succeeded in fifteen years is a matter of history

There is no doubt that our efforts have been a great factor in placing the science technique and administration of surgical practice in a supreme position of efficiency. Eight thousand eight hundred Fellows of the College of Surgeons are now pulling together to raise the practice of surgery to the highest degree of perfection. Many clinical organizations are following in the wake of this great movement. There is no longer provincialism in American medicine. It is unusual for doctors to be satisfied with their own efforts. We are traveling, observing and learning to practice safe surgery.

The College is the accepted leader in bettering the hospitals of the United States and Canada

and its example has aided the hospitals of Latin America Australia New Zealand and other countries of the civilized world. It has been a revolutionary movement of transcendent value to the public and to the profession.

There is no doubt that clinical surgery has been stimulated in the different localities and the people aroused to a knowledge of the ideal which motivate the Fellows of the American College of Surgeons through the sectional meetings of the College inaugurated in 1906 for the purpose of bringing a miniature Clinical Congress into the states and provinces and carrying to large groups of laymen and women the story of scientific medicine.

There is no doubt that our interest in the admission to the College which requires the filing of 100 case records has impelled recognition of the value of records and has been the means of educating our profession to write better case histories to improve their literary ability and critically to observe scientific facts.

#### VIII. THESE ARE IDEALISTIC ACTIVITIES— WHAT ABOUT THEIR ADMINISTRATION?

After the sessions of this meeting in Boston in which each department of the College has been reported upon and discussed it is needless to review them in the brief time at my disposal.

Our program and leadership in the betterment of hospitals is now accepted by the national and international hospital associations and by their great journals by the departments of the United States government the Army the Navy the Public Health Service the Veteran Bureau and the National Homes for Disabled Volunteer Soldiers. The South and Central American republics Australia and New Zealand have studied and in many places have adopted our standard.

The most convincing evidence of the acceptance of our standard and leadership is the fact that our eleven surveys have stimulated great improvement in hospitals. In 1918 12.9% of the hospital with 100 beds and over met our standard. In 1928 93.1% 50 to 99 bed hospitals 41.3% in 1927 and 6.2% in 1928 5 to 49 bed hospitals 15.9% in 1924 18.1% in 1928. Government hospitals have advanced from 90.0% in 1925 to 100% in 1928.

In many instances these surveys when first instituted were considered an interference now they are sought after and welcomed. Any community deems it a tragedy to possess a hospital that is not on the approved list of the American College of Surgeons.

## IX. CLINICAL RESEARCH

Clinical Research has been organized as a distinct department with an Associate Director in charge. It comprises

1. Committee on the Treatment of Malignant Diseases with Radium and \ Ray Robert B. Greenough Chairman
2. Committee on Bone Sarcoma (historically known as the Ernest Amory Codman Registry) Dallas B. Phemister Chairman
3. Board on Traumatic Surgery Frederick A. Besley Chairman
4. Committee on the Treatment of Fractures Charles L. Scudder Chairman
5. Standardization of Clinical Laboratories

These Committees consist of strong boards of clinical practitioners and administrators who seek to furnish through their activities an annual report of the consensus of opinion of leading clinicians on their respective problems

## X. RESEARCH OF LITERATURE

Our Literary Research Department is making available to clinicians an organized and authoritative means of obtaining through trained workers what they desire in medical literature—either in the form of an abstract of a bibliography or of extensive research of the literature in all languages. Service of this type accessible to all clinicians whether members of the College or not takes that important work out of the hands of unorganized commercial individuals or unsatisfactorily financed organizations and offers reliable censored service at less than actual cost and the expense is gradually diminishing because of our ability through proper organization to accumulate valuable material.

## XI. MEDICAL MOTION PICTURE FILMS

Motion picture films can and will occupy an important place in the teaching of medicine. This fact is conclusively proved by the very great interest which has been manifested in the program of medical motion picture films which the American College of Surgeons is fostering in co-operation with the Motion Picture Producers and Distributors of America Inc. and the Eastman Kodak Company—a movement which gives greater promise than any other program that the College has undertaken—a movement that will result in the development and distribution of the highest grade of medical motion pictures.

The preliminary survey of films already produced conducted by the College reveal an astonishing amount of effort principally by individuals with many commendable results. However there

is opportunity for an epoch making advance in education in general and in medicine in particular and this opportunity is being utilized by our affiliated organizations.

## XII. FEE SPLITTING

It was a bold stroke when the American College of Surgeons at its initial meeting declared against the division of fees between practitioners of medicine and surgeons. It requires courage to discuss the abominable practice which reduced to its ultimate terms is simply a traffic of patients between these two groups—the buying and selling of patients with the highest bidder the purchaser regardless of his ability. It requires courage to discuss the subject because in so doing we must acknowledge that there are unworthy men in our own profession. It is a menace however that can be eliminated only through frank recognition by the profession and education of the public.

This vicious practice will cease only when every member of the profession has the courage and the honesty to present his individual bill for services rendered and when the public will insist upon paying each the practitioner and the specialist for his individual service.

One of the qualifications for Fellowship in the College requires each and every candidate to sign a declaration against the practice of the division of fees either directly or indirectly in any manner whatsoever.

Each one of the five or more individual references named by a candidate in support of his application must state in writing over his signature that to his knowledge and belief the candidate does not practice the division of fees.

Each State of the United States and each Province of Canada has a Credentials Committee elected by ballot by the Fellows of the College in the respective State or Province. When an applicant's name comes before his respective Credentials Committee the acceptability of the candidate from the standpoint of division of fees must be voted upon.

The Central Credentials Committee of the College makes a careful scrutiny of the candidate's environment and methods of practice and especially of the standing of the hospital in which he does his surgery.

Finally any charge against a candidate or a Fellow of the College is carefully followed up by the central office and evidence sought upon which proof may be based. For obvious reasons it is difficult to secure positive proof of fee splitting which would be accredited in court of law. When such proof is obtainable the Fellow must be given

an opportunity to appear before the Board of Regents and make his defense. Seldom will a guilty man appear. The alternative is acceptance of his resignation or summary dropping of his name.

The most effective safeguard against splitting is the standardized hospital. It is difficult for a Fellow on the staff of an approved hospital to divide fees unknown to the officials of the institution or at least without their suspicion. When we receive rumors or charges that an individual is practicing in one of our accepted hospitals, splitting fees, we inform the authorities of that hospital that such rumors have come to us, that the hospital will be surveyed, and that the survey must satisfy us that the charges are unfounded. Through this procedure we immediately eliminate cooperation not only of the hospital officials but of every honest member of the staff. Ignominations from staffs for reasons within their knowledge are frequently reported.

However, the American College of Surgeons includes in its membership only 5,500 of the 104,000 doctors of medicine in the United States and Canada. Our jurisdiction extends only to our Fellows and to 1,000 standard hospitals. In organizing a protest against the practice of the division of fees and dilatorily postponing the responsibility of attempting to eliminate it from our own organization, we must accept the responsibility of becoming the mark for criticism by those who have reason to distrust us, and of so criminal a practice.

I am in a position to know, however, that fee splitting is very rare in the ranks of the College of Surgeons, and that our publicity campaign has caused much misinterpretation within our ranks who continue its practice.

At one of the Credentials Committee meetings in an important state with some present, I considered a long list of candidates for admission to the Committee rather more belated than informed said. Until you receive your whole plan of selecting candidates, you will fail. Practically every member of the College in this state (excepting myself and one other individual (mentioning him by name) is splitting fees. He got the retort for which he was playing. Practically every other member of the Committee honestly and indignantly resented with emphasis this unjust accusation.

There is but one procedure when insinuations are made and that is to ask: How do you know? The College insists on proof and proof is difficult to obtain unless the accuser acknowledges that he is a party to the transaction.

### XIII SUCCESSFUL LEADERSHIP IS MAINTAINED BY MAKING GOOD

An undertaking cannot be successful without appealing ideal. Ideals cannot be realized without a sane program which will make them come true, and a sane program cannot be successfully executed without sound financing and wise administration.

To advance clinical surgery, to pursue a sound program for the improvement of hospitals to make a drive against unworthy financial dickering, to assume active interest in the standardization of surgical methods and the elimination of unnecessary operating to aid literary clinical and industrial research—in a word to accept progressive leadership in the teaching and practice of medicine in educating the lay public in the value of scientific medicine—it was obvious that a businesslike plan of financing would be necessary.

Our financial arrangement at the beginning was based on the custom current in the old societies, a twenty-five dollar initiation fee and five dollars a year dues. After two years we realized that this would leave our program without financial support. The founders of the College, represented by our Board of Regents, were not satisfied to back another national organization in medicine if it did not possess the financial resources necessary to carry forward reforms that it had undertaken.

At the June 1914 meeting in Philadelphia the Regents started a movement that would eventually result in a permanent endowment fund. A new society regardless of its worthy ideals could not expect to interest outside financiers in an endowment on the basis of paper aspirations. The Regents at their morning session sold the project to themselves and decided to take it before the Fellows at a meeting that afternoon and ask the support of volunteers.

The desire was to secure one thousand \$500 pledges from such members of the College as were willing and able to subscribe. As the interest on \$500 would represent the amount of the annual dues it was suggested that this amount would constitute a life membership contribution. Every dollar pledged to the endowment would be invested in trust securities and no part of the principal it was stipulated should at any time be expended.

One Hundred and Thirteen Thousand Dollars were subscribed at that first meeting and by December 1915 the subscriptions totaled \$526,000. Later the Regents allocated a portion of the initiation fees to the endowment and unexpended surpluses from annual dues. The endowment fund today invested in gilt-edged trust securities

which yield slightly over five per cent has reached \$802 600

At the 1916 meeting in Philadelphia our By Laws were revised the initiation fee increased to \$100 00 and the annual dues to \$25 00

#### IV A PERMANENT SITE

From the beginning a friendly contest ensued in the selection of a permanent home Washington New York Philadelphia Chicago and Cleveland were the principal contestants It was easy to reach a decision but who would finance the site? Washington as the capital of the United States led as the ideal location in the East Chicago was a close second because it is the geographical and population center The untimely death of one of our beloved founders John B. Murphy led his lay and professional friends to ask the College if it would accept a permanent site in Chicago upon which a home for the College would be builded and presented to the institution as a memorial to Doctor Murphy This plan failed because of the sudden death of two of its principal lay supporters

The effort however had crystallized opinion and caused the Fellows of the College to vote in favor of Chicago as an acceptable location for the permanent home This decision resulted from the assumption that a completed home on an acceptable site would accrue to the College without cost

At a meeting of the Board of Regents in June 1919 with President William J. Mayo in the chair the question of site became acute Chicago had made a promise and on that basis she had received the favorable vote Chicago must satisfy the Regents that a site in that city was available or the contest for permanent home would be reopened The arbitrary Chairman would brook no delay This was June 25th If Chicago did not produce by August 15 satisfactory legal evidence that an appropriate site would be presented the Regents would look elsewhere The Chicago contingency recognized the futility of argument with the relentless power the presiding officer and realized that immediate action was necessary

Within three days a site was selected which had upon it a stately building that would make a satisfactory administrative headquarters The President was called upon to approve Take that was the laconic reply In one month the business men of Chicago had subscribed three fourths of the purchase price and members of the profession and Fellows of the College in Chicago the additional one fourth On May 1 1900 the administrative offices of the American College of Surgeons were transferred to the permanent location

The site also contained a suitable plot of vacant ground upon which the friends of Doctor Murphy asked the privilege to build the belated memorial and proffer it to the College as one of its administrative units This offer was accepted The corner stone was laid on October 23 1923 and on June 10 1926 the Murphy Memorial building was presented to and accepted by the College This useful structure contains assembly halls library and temporary museum space It was built at a cost of \$500 000 and involved no outlay on the part of the College

In the meantime the ground value of our property has advanced and with its buildings it is conservatively appraised at \$1 50 000

#### V OUR BUDGET

Our budget for 1928 divides itself as follows

Hospital Department	\$65 000
State and Provincial Sectional Meetings	20 000
Credentials Committee Meetings	25 000
Clinical Research	5 000
Library	20 000

The funds for this budget come from the dues paid by Fellows of the College

#### VI LATIN AMERICAN ACTIVITIES

As to the financing of Latin American activities Our actual surveys in Latin America followed vacation trips that were made in 1920 by Dr W. J. Mayo and his family and Mrs. Martin and myself and in 1921 by Dr. and Mrs. Thomas J. Watkins Mrs. Martin and myself Several surveys were made In 1921 and 19 by Dr. Francis P. Corrigan of Cleveland in 1922 1924 and 19 by Dr. Edward I. Salisbury These surveys together with expenditures incident to literature and correspondence were met by a surplus which accrued from exhibit charges at the annual meetings of the Clinical Congress funds which belong to the College but which are in no way contributed toward from our investments or the dues of the Fellows For convenience of book keeping these funds have a separate ledger account in the College books as the Regents have always felt that the Clinical Congresses which are attended at any one time by not more than one third of the Fellows should be self supporting The Congress is self supporting and its surplus is available for expenses of an extraordinary nature which would not come within our stipulated budget for academic activities

One cruise was arranged for individual members of the College their families and friends This cruise was conducted without one cent of expense

to the College. It was financed by the individuals who participated in it.

### VII OUTSIDE FINANCIAL AID

A new enterprise will not draw financial support from business or philanthropic sources regardless of the extent of its program and worth of its ideals. It must first make good. Its activities and accomplishments must attract the attention of the public. It must create an impelling sales power before gifts can be successfully solicited or voluntary contributions offered.

This has been the experience of the College. With the exception of donations from our own Fellows or appropriations obtained through special friends for specific purposes until recently we have not attracted business or philanthropic contributions. Within the last two years a change is noted in the attitude of the public. In that period we have received moneys to be used in special work in our departments as follows: From three individual sources for special hospital activities and research \$15,000, \$5,000 and \$10,000. The Board on Traumatic Surgery is receiving \$20,000 and \$5,000 which we have reason to believe will be duplicated. Our backing and our program are being recognized.

### VIII BUSINESS METHODS

Much planning, successful persuasion and many refusals, polite and occasionally otherwise, have resulted in building our still youthful organization on a sound basis financially.

No organization can be considered on a sound financial foundation if it does not have the backing of a watchful and thrifty administration and no foundation can be so unstable as a financial one. We may compliment ourselves on our satisfactory financial progress. But as an interested bystander who has experienced the difficulties of accumulation I tremble to anticipate what will happen to our \$2,000,000 assets if an orgy of administrative mismanagement should ensue even for a brief period.

From the beginning of our work the Regents with disinterested persistence have supported the idea that they were administering a public trust. They have held sacred that trust.

It is not always an easy task to instill that same attitude into the minds of half a hundred employees. Associates in our work are selected for their ability in a particular line, for their initiative for their independence and for their enterprise and industry. These qualities must be molded so that each may realize that while he is expected to perform a specific task, he must also

fit into and co-operate with the comprehensive program which involves the labors of several other individuals who are responsible for different tasks in the same organization. In other words an *esprit de corps* must be developed which makes each one loyal to the entire program of work in hand.

Furthermore it is incumbent on each department to lie within its stipulated budget. It is indeed gratifying to find one of these enthusiastic individuals exerting every effort to remain within the financial bounds that he himself has helped to arrange. It indicates commendable enterprise. However year by year he plays the game in the hope that his important work will draw a larger portion of the budget and thus make possible even greater accomplishments the succeeding year.

To get the very best from our individual associates it is necessary for each to regard the whole. An uncensored undiplomatic letter written by an indignant associate to a Fellow who has been guilty of a misdeed may involve unpleasant consequences. To be cautious and discreet are among the chief injunctions to every one engaged in our activities.

From the beginning the management has insisted upon conducting the routine administration of the College on the strict principles of business. While ours is an educational institution, each one of us is made to realize that he is dealing with trust funds. It may be old fashioned but if a telegram can express its meaning in ten words, eleven words are not allowed. Nor is a telegram sent in place of a letter if the letter will accomplish the same end.

Time too is considered a financial asset. The loss of half an hour by a careless or indifferent aid when multiplied by forty, the number in service, would result in the loss of twenty hours, three and one half days work. The careless one is not allowed to go uncensored in this breach of fair play. And it is gratifying to testify that our great family is in entire sympathy with these reasonable requirements.

### IX REQUIREMENTS FOR FELLOWSHIP

Important as are these administrative regulations, the most difficult policy to establish was one that would enable us to select for Fellowship only the qualified surgeons and surgical specialists. This involved a study of measures adopted and in use by the time honored Colleges of Surgeons of England, Ireland and Edinburgh. It was found that almost without exception their requirements and tests were formulated before modern surgery came into existence. They are similar to those

which are now exacted of internes and hospital aids to ascertain the candidate's knowledge of academic facts instead of his practical ability to apply such knowledge toward the accomplishment of deeds

After thorough and careful study of the whole problem there was no reason why we should begin by adapting obsolete plans to a 20th century program

What requirements then should the medical practitioner meet that we may recommend him to the public as a reliable surgeon?

First He must have graduated from a Class A medical college (or its equivalent) and he must have served at least one year as interne in a creditable hospital and two years as surgical assistant or he shall give evidence of apprenticeship of equivalent value

Second Five to eight years after graduation in medicine devoted to special training and to practice are normally the time requirement for eligibility to Fellowship so the candidate may prove that he has the proper temperament and is mentally and mechanically adapted to do surgery

Third The moral and ethical fitness of the candidate as a physician and as a citizen shall be determined by reports of surgeons whose names are submitted by the candidate himself and by such other reports and data as the Credentials Committee and the administration of the College may obtain

Fourth The professional activity of the candidate shall be restricted to study diagnosis and operative work in general surgery or in special fields of surgery His specialization in surgery or one of its specialties must be not less than 85% in communities of more than 50,000 inhabitants and 50% in smaller communities

Fifth He shall do his work in a hospital or in institution that will give him the benefit of scientific facilities and the aid of competent assistants nurses and associates

Sixth He shall make formal application for Fellowship which will record full data regarding his educational opportunities his medical training and post graduate work and his literary efforts and he shall give the names of not less than five personal references

Seventh This information and the replies from his references are referred for careful scrutiny by his State or Provincial Committee on Credentials which is a committee of Fellows of the College ranging in number from eighteen to thirty six Full information is sought and each member of the committee is required to vote to accept postpone or reject the applicant Candidates are

considered with such care that not more than one of every four is accepted at any one meeting

Eighth Not until the candidate is accepted by his State or Provincial Committee is he required to file with a committee of competent surgical specialists a sufficient number of case records of major operations which he has performed himself that the committee may definitely determine his surgical judgment his diagnostic accuracy his technical skill acceptable environment his dependence on laboratory findings his acceptance of consultations and his immediate and remote results These records are carefully scrutinized by a committee of practical surgeons teachers in the four Class A medical schools of Chicago This examination is thoroughly and consistently conducted Great care is exercised and the standards of the examiners are very high From 25% to 51% of the records are not accepted as sufficient evidence of qualifications for membership

This careful surveillance from the filing of the original application until the routine of investigation is successfully completed consumes from two to four years of time The applicant's record is finally submitted to the officials of the College for consideration and as a last act to the Board of Regents

We are proud to submit this program as one that will reveal the qualifications of a surgical practitioner and when successfully negotiated the candidate may be recognized as a real surgeon spiritually and morally worthy of Fellowship in the American College of Surgeons

Briefly these are the qualifications that have been met by this fine group of men who have been received into the College this evening for which occasion you have honored us with your presence The majority of our candidates have been in practice since graduation from medical school much longer than the required seven years

We believe that our requirements possess advantages over the purely academic Imagine asking William Mayo or Edward Martin to submit to an academic examination to prove their ability to qualify as surgeons! Not only would it be difficult for them to pass such an examination even after months of cramming but in the meantime the world would lose their services as practical operators

## XX JUNIOR CANDIDATE GROUP

The Junior Candidate Group forges another strong link in our propaganda against unworthy financial practices Through it the College purposes to accept these candidates when qualified and place them on a probationary list (unpub



lished) as early as two years after graduation. They are required to fill out and sign the same application blank and anti fee splitting pledge as is required of all Fellows of the College. Annually their names if approved are reconsidered by the respective State or Provincial Committee on Credentials.

Seven years after graduation if they desire to apply for regular Fellowship they must submit another application again sign the anti fee splitting pledge be reconsidered by the respective State or Provincial Committee on Credentials and if approved submit the necessary case histories.

The Junior Candidate group furnishes a young surgeon a tie of great importance in the formative days of his career.

### XXI APPRECIATION OF OUR EFFORTS

In these short but strenuous years we have been rewarded by the appreciation of organizations and of many loyal and eminent men of vision and accomplishment. The Royal College of Surgeons of England honored us at our first Convocation by sending to us its distinguished President the nephew of Lord Lister—Sir Pickman Godlee. In appreciation of our efforts in the Great War (for which 90% of our distinguished Fellows enrolled for service to support the efforts of our allies) the Consulting Surgeons of the

Armies of Great Britain presented to the College the Great Mace which now and for all time to come will lead our ceremonial processions.

Of transcendent importance our ideals and standards have been accepted by 1919 hospitals of the United States, Canada, Central and South America, Australia and New Zealand. These ideals and standard are enthusiastically welcomed by surgeons, internists and specialists and they have commanded also the recognition of medical schools, medical associations and nurses. Of greatest importance they have secured the recognition and following of the great lay public.

### XXII THE HERITAGE

This is the heritage that our new Fellows receive from the old. It is the gift of the Old Guard to the New Guard, this New Guard—of which you who have but just now received your Fellowship are a part—must begin to assume the obligations that were so well maintained by the Old Guard who sit about me and who have honored you and me by their presence on this fifteenth anniversary. They are still reluctant to release their responsibilities until they are convinced that younger minds have caught the vision, appreciate their opportunities and are willing to labor—and fight if necessary—for the honor of the American College of Surgeons.

